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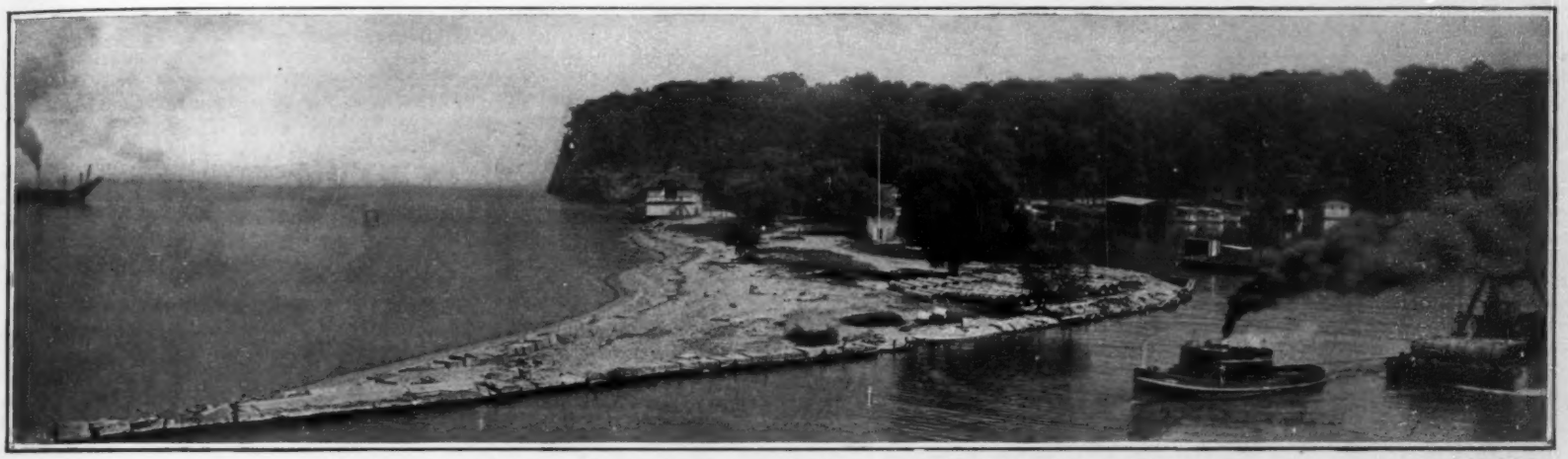

Towing sections of Cleveland's concrete sewer out to where they will be laid on the lake bottom

Sewer Pipe Laid on Lake Bottom

A VERY interesting engineering proposition is being worked out at Cleveland, where a large outfall sewer is about to be laid on the bottom of Lake Erie for a distance of 3,400 feet. The use of cast-iron pipe, which is the usual mode of procedure for work of this kind, would have been attended by considerable increased expense at this time and would have entailed a delay of more than a year. The concrete pipe are cast on the site with ends shaped in the casting so that a tight joint is secured and at the same time there is sufficient flexibility to permit of its conforming to the irregularities of the surface of the lake bottom. These precast sections are floated out on barges, sunk, and set in place by divers in trenches which have been previously prepared but are entirely devoid of piling or anything like foundation.

The first work of this character has been recently completed at Lakewood, a suburb of Cleveland where the pipe made use of was much smaller but the success of the scheme was fully demonstrated. Here, too, there was a departure in the shape of the metal bell and spigot ends which were made use of in the pipe ends, but in the interest ot economy this use of metal has been dispensed with in the case of the Cleveland sewer. Here the joints were made in the concrete cast to the proper shapes in accurately machined molds.

The Cleveland outlet sewer is being built by the city at the foot of East 140th street. The pipe made use of here is 84 inches in diameter and 20 feet in length. These are cast in one piece and in one operation at the water's edge near the site of its final interment. They were cast on end as shown in one of the accompanying photographs. The machined cast for shaping the end is laid and the reinforcement tied to this and then a cylindrical mold lowered about the reinforcement. Into this the cement is poured. It is not found necessary to make any provision against the greater pressure at the bottom of the mold.

For making the joint between the two ends, a 1¼-inch iron pipe is set in the shell of the concrete pipe to a depth of about six inches and at a point about eight inches from the end of the pipe. In these pipe threads are tapped and the eyebolts screwed in and through the eyes of these latter bolts 1¼-inch tie-bolts are passed. In order to take up the reaction of these tie-bolts, however, the vertical iron pipes carrying the eye-bolts are held together through the 20-foot length of the pipe by one ¾-inch rod hooked around the pipe insert and imbedded in the shell of the concrete pipe. A heavy asphalt paint is placed on the hemispherical faces ot the joints, so that when they are brought to bearing there will be an amount of the composition forced out and this will make a tight joint.

The length ot this pipe is 3,400 feet and all of this with the exception of 1,000 feet is 84 inches in diameter. The end of the line tapers down to a minimum of 48 inches with openings at intervals for the escape of the sewage. This of course receives the necessary distribution over a considerable area of the lake bottom.

The flexible joint of a concrete pipe section

The mold for concrete sewer pipes, and the arrangement of the reinforcement

Geology in the War

WHEN on June 7th, 1917, the largest blast ever set off was exploded under the Wytschaete-Messines Ridge, everybody concerned, from the British Commanding General down to lieutenants of sappers, was mentioned in the dispatches—with the exception of the eminent British geologists whose scientific research and skill made the success of the huge engineering feat possible. For this operation was the spectacular culmination of weeks of geological study, in which the ablest men in this branch of science participated. It was one of the most striking examples of the manner in which every department of scientific knowledge and every man who can qualify as a scientist is being utilized by the Allies in the effort to crush Germany.

The Messines Ridge, to use only the shorter and more generally used part of the name of the hill that dominates Ypres from the south, was in the possession of the Germans. The success of the Allied military operations in that part of the front depended upon dislodging the enemy from this exceptionally strong position. All efforts to take the hill by storm failed, with great loss of life. Only one plan of operations seemed feasible—to mine the entire ridge and literally blast it off the face of the earth.

The actual mining offered no particular engineering difficulties, but mining is an operation that takes time, and anything that requires an appreciable time for its completion in this war is reasonably certain to be discovered by the enemy before it is finished, so difficult is it to hide any sort of activity from the prying eyes of the scouting airplane. There seemed to be no way to undertake the gigantic scheme of mines that would be necessary without inevitable discovery that would give the Germans the cue to sink countermines and render the whole operation futile. At this juncture the geologists were called in.

All of the region through which the battle-lines pass has been studied by geologists for a century or more. There is not a square inch of the surface that has not been minutely mapped, while the underlying formations and strata are as familiar to geological students as though they had been exposed in cross-section. Both the French and the Belgians have published many excellent gological maps of the entire terrain. Armed with these maps and the available data, the scientists made their report to the British General.

"If you mine in this direction, and at this depth," they said, indicating certain positions on the map, "you can work without fear of countermines, for at these points which we have marked there are beds of quicksand, whose depths and areas we have here indicated, so located as to render countermining by the Germans impossible."

The counsels of the geologists were heeded. Mining operations had been under way but the briefest time

(Concluded on page 371)

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The object of this journal is to record accurately and lucidly the latest scientific, mechanical and industrial news of the day. As a weekly journal, it is in a position to announce interesting developments before they are published elsewhere.

The Editor is glad to have submitted to him timely articles suitable for these columns, especially when such articles are accompanied by photographs.

Shooting Through the Ocean of Air

THE sensational German feat of dropping shells on Paris has awakened a great deal of interest in the nature of the air through which the shell plows its way on its 120-mile course; for while the actual range of the gun is in the neighborhood of 75 miles, assuming that the gun is elevated to an angle of 43½ degrees, the shell must rise to an altitude of about 24 miles above the earth. We do not know much about the condition of the atmosphere above an altitude of 7 miles except by theoretical reasoning. The maximum elevation ever reached by man is probably that attained by Glaisher and Coxwell on September 5, 1862. Mr. Glaisher made his last observation when his balloon had carried him up 29,000 feet. He was then ascending at the rate of 1,000 feet per minute. Shortly after that he lost consciousness and Mr. Coxwell, his assistant, also began to lose the use of his muscles. However, he succeeded in stopping further ascent by pulling the valve cord with his teeth, as his arms were powerless. Thirteen minutes later Mr. Glaisher regained consciousness and then found that his balloon was descending at the rate of 2,000 feet per minute; from which he estimated that, in the interval, they must have reached the extreme altitude of over 36,000 feet. In 1901 the German balloon Preussen reached an altitude of 35,100 feet. These are the highest altitudes ever reached by man, and they are not one-third of the altitude that must be reached by the shells fired from the Forest of St. Gobain.

Judging from the curve of pressures recorded in the lower strata of the atmosphere it is assumed that there is a very high vacuum at that height. Of course, this does not mark the limit of the earth's atmosphere. Meteorites come shooting down to the earth with velocities up to 20 miles per second leaving a trail of fire caused by the friction with the air or with gases surrounding the earth. These trails have been observed as high as 200 miles, but it is probable that at a height of 24 miles there is so little air that the sky loses its blue appearance, because there is hardly enough of it to produce the refraction of light which gives it its luminosity. And so, if we could accompany this shell on its course, we shoul probably find the sky growing darker and darker, until it became nearly black. In the black sky the sun would show as a ball of fire, while the stars which were not obliterated from view by glare of the sun's light, would also be visible. Below us we should have the reflection of sunlight from the earth and from the denser strata of the atmosphere.

It is a pity that some means could not be devised for recording the meteorological conditions of the regions traversed by these shells. The data would be of such importance to science as to give real value to this freak piece of ordnance.

Bending Stresses in Concrete Ships—A Warning

IN uttering a word of warning with regard to the construction of concrete ships of large size, it is not the intention of the SCIENTIFIC AMERICAN to play the part of alarmist, or to discourage the United States Shipping Board in its plans for the construction of a fleet of ocean-going, concrete vessels. At the same time, we wish to draw attention to the fact that it is taking a tremendous stride in an entirely new type of ship, to pass so quickly from a concrete barge, even of the largest size, destined for operation in sheltered waters, to a large ocean-going vessel that will have to face the furious gales which are encountered in transatlantic service.

And in saying this, we are well aware that the wide gap has been somewhat bridged over by the construction of one or two small, concrete, seagoing steamers, which are reputed to have given good service.

The particular stresses about which we feel concerned, and in providing for which the naval architect should exercise great care and discrimination, are the bending stresses to which a long ship is subjected, when it is being driven against seas that are heavy and steep; for we are mindful of the fact that when steel ships first began to run into great length and very high speed, they developed serious girder weakness. The first notable instance of this was the 600-foot liner, "Lucania," of the Cunard Line, which worked so badly in a seaway that plating was buckled and pipe connections were broken. The same trouble developed in the 23½-knot, 650-foot "Deutschland" of the Hamburg-American Line. With a view to testing the actual amount of deflection, this ship was driven at full speed into an extremely heavy sea, and instrumental observations were made which showed that the maximum bending amounted to over 11 inches in the whole length of the ship.

When the plans of the "Lusitania" were being drawn, particular attention was paid to this problem; and in order to provide sufficient girder strength, a special, high-tensile steel plating was rolled, and utilized in three thicknesses along the middle third of the ship at the topsides. The turn of the bilge, if we remember rightly, was double plated.

We had an opportunity to observe the behavior of the ship under conditions which put her longitudinal strength to a most severe test. This occurred during a trip to the westward, when she was being driven at full power in the attempt to win the Government subsidy of $375,000, which would be secured if she maintained an average speed of 24½ knots for a round trip between New York and Liverpool. The seas were running, according to her captain, fully thirty feet in height, and the full power of the turbines of 70,000 horsepower was being developed. At the height of the gale, we measured the movement of the expansion joints on the boat deck and found that it slightly exceeded one inch, which would indicate a total amount of bending, under the conditions when she was wave supported at the center or at the ends, of about twelve inches. It should be mentioned here that in addition to the reinforcement of the side plating, additional girder strength was secured by constructing the upper decks of extra heavy steel plating.

Now the moral of all this for the designer of concrete ships is, that he should provide sufficient steel reinforcement to take care of these stresses under such exceptional weather conditions as we have mentioned above. We understand that the 8,000-ton concrete ship which was recently launched at the Pacific Coast yard, has been put to a series of sea tests, which have demonstrated to the satisfaction of the Shipping Board, that she is a thoroughly staunch and sound vessel, and we presume that the tests included a series of trials both in the light and heavy loaded conditions in the worst possible kind of weather.

Tests of this kind, to be complete, should include a run through a heavy quartering sea, when the ship would be subjected to considerable tortional or twisting stresses; for it is evident that when, say, the starboard bow is entering a sea at the time when another sea is leaving the port quarter, the center of displacement at the bow will move over to starboard and the center of displacement at the stern will move over to port and a severe twisting moment will be set up within the ship's structure. Proof of this will be seen by an examination of the expansion joints in the upper deck, which, under these conditions, instead of having a fore and aft movement will have a horizontal rotary movement with respect to each other. A naval architect with whom we discussed this subject, told the writer that, during the trial trip of a large passenger ship which he had designed, when the ship, in rounding a certain cape, changed her course from one at right angles to the seas to a course diagonal to the seas, he noticed this change from a fore-and-aft to a rotary motion at the expansion joints, and that he came to the conclusion that the phenomenon was due to twisting moments set up by the quartering sea.

It is consideration of the above conditions which leads us to express the hope that, before the country is committed to an extensive construction of reinforced-concrete ships, additional and extraordinarily severe tests will be carried out upon a vessel of large size and considerable length.

An Anti-Submarine Barrage

SIR ERIC GEDDES, the British First Lord of the Admiralty, recently made an unexpectedly frank statement regarding the measures adopted for preventing hostile submarines from getting into the English Channel from the North Sea by way of the Straits of Dover. He said: "It is commonly believed that, from the early days of the war, the passage of submarines through the Straits has been prevented by nets or other obstructions. This is not the case, and undoubtedly a considerable number passed through towards the end of last year. A more vigorous policy was adopted quite recently. A surface barrage has been maintained across the Channel, in order to obstruct the passage of enemy submarines. By day and night this barrage is maintained, and at night the patroling craft—which number over 100—burn flares, so that any submarine attempting the passage on the surface has a reasonable chance of being engaged."

In a general way the details of such a barrage may be easily filled in. Submarines have only a limited amount of underwater endurance—the maximum for any craft is believed to be in the neighborhood of 140 miles—after traveling which the vessel must come to the surface to recharge her batteries. It follows, then, that if the Channel were closely patrolled for a distance of 150 miles no such submarine could get past without coming to the surface at some place within the barrage, with the risk of being engaged by surface craft—a risk which German submarines naturally seek to avoid. It is evident, however, that the 100 patrol craft mentioned by Sir E. Geddes would be useless if spread over such a length of sea, so it becomes obvious that the barrage must take a more concentrated form—in other words, something must be done to compel the U-boat to come to surface within a definite and easily watched area.

How can this be achieved? Obviously by the use of mines. In a relatively narrow passage like the Dover Straits it would be feasible to lay a mine field, a few miles in width, of such a character as to make it virtually impossible for any submarine to get through, while at the same time leaving an ample depth of water—say between 30 and 35 feet—for ordinary traffic and for the maneuvering of the patrols. On reaching the edge of the minefield the U-boat would have a choice between trying to wriggle her way through—a somewhat precarious business—and rising to the surface and trying to run across it to the other side. With even thirty feet of navigable water she would run considerable risk of betraying her presence (the unusually big "Deutschland," which visited America in 1916, was 34 feet from the top of her conning tower to her keel), and in anything less than that, she would make an easy sight for the keenly-watching patrols and would be promptly forced to choose between fighting her way through and risking the depths with their mines and depth-charges. The use of an enormous number of flares to illuminate the surface of the barrage during the night has a rather fantastic sound—and the sight must indeed be fantastic; but it seems to be a very simple and practical way of securing what is most needed at night for the purpose in view—visibility. Mr. Pollen is anxious for what may happen if some of the enemy's heavily-armed submarines try to get through the surface barrage. With their 5.9-inch guns they could certainly make hay of any number of average trawlers and drifters; but on the other hand there is no reason for thinking that the surface patrol is not shared by much more heavily armed vessels than these. Anyway, it is always open to the Germans to put the matter to the test.

The question naturally arises, would it be possible to extend this barrage system to the other end of the North Sea—to lay, maintain and patrol a band of water ten or twenty miles wide between Scotland and Norwegian territorial waters? Early last year Mr. Churchill, an ex-First Lord of the Admiralty, suggested the close patrol of an area some 150 miles in width, on the principle and for the purpose stated early in this article. As the length of this "gateway" is more than 200 miles an enormous number of vessels would be required for the purpose; but if a mine barrage could be established the necessary number would be very greatly reduced. If the system in force at Dover continues to be successful, the responsible naval staffs will doubtless consider very fully its possibilities further north, where, however, the difficulties are obviously very much greater.

Time Saved by Reading Official Bulletin

OWING to the enormous increase of Government war work the governmental departments at Washington are being flooded with letters of inquiry on every conceivable subject concerning the war, and it has been found a physical impossibility for the clerks, though they number an army in themselves now, to give many of these letters proper attention in reply. There is published daily at Washington, under authority of and by direction of the President, a Government newspaper, the *Official Bulletin*. This paper prints every day all of the important rulings, decisions, regulations, proclamations, orders, etc., as they are promulgated by the different departments and the many special committees and agencies now in operation at the National Capital. This official journal is posted each day in every post office in the United States, more than 56,000 in number, and may also be found on file at all libraries, boards of trade, chambers of commerce, and the offices of mayors, governors, and Federal officials. By consulting these files most questions will be found readily answered; there will be little necessity for letter writing; the unnecessary congestion of the mails will be appreciably relieved; the railroads will be called upon to move fewer correspondence sacks; and the mass of business that is piling up in the Government departments will be eased considerably. Hundreds of clerks now answering correspondence will be enabled to give their time to essentially important war work.

Engineering

The Muscle Shoals Dam.—The construction of Dam No. 2 at Muscle Shoals on the Tennessee River, where power is to be developed for the fixation of atmospheric nitrogen, is in the hands of Lieut. Colonel Hugh L. Cooper of the U. S. Engineer Officers' Reserve Corps. Colonel Cooper is well known to our readers as the engineer who constructed the great dam across the Mississippi, at Keokuk, Iowa.

An Enormous Sand Digger.—A large ladder dredge has recently been constructed for use at Neville Island, Pittsburgh, for dredging sand and gravel. This dredge has a ladder that will reach 50 feet below the surface of the water. It brings up the sand and gravel and delivers it into a revolving screen on the main deck. By means of secondary ladders the screened material is raised from tanks in the hull of the dredge to chutes that lead into barges alongside.

"Daylighting" Highway Curves.—The California Highways Commission has been making an effort to better conditions on its roads by the use of a plan known as "daylighting" curves. The danger on a curving road in a hilly country is recognized by all motorists. When the curve passes around a hill there is usually a high embankment which prevents the driver of a car from seeing what is coming around the curve from the other direction. The plan is to excavate a berm or bench on the slope at the inside of the curve, at a height of about 3 feet above the roadway, which is taken to be a little below the line of sight of the driver. Where the work is difficult owing to the nature of the material, the berms are made five or six feet wide, but it is found preferable to use berms 12 feet wide. On a curve of 100 foot radius a five-foot berm will enable motorists to see each other when 95 feet apart. If the berm is increased to 12 feet this range of vision is 115 feet or 124 feet along the road. In this way the danger of blind curves is materially reduced and if cars are traveling at moderate rates there is plenty of time to avoid a collision.

Planers Built of Concrete.—An important development in mechanical engineering has been brought about by the necessity of building machines for the construction of large guns. To build gun-boring machines which require very long ways, it is necessary to have enormously long planers. As time is a very important element in the war, interest is attached to two novel planers recently built in Chicago of concrete in place of metal. Of course, these planers are provided with metal parts where finished surfaces are required, but the bed of the planer and the platen are made of concrete and so is the housing and cross rail. The bed is 148 feet long and the platen 92 feet long. The platen is 13 inches thick and the concrete cross rail is four feet square. The top of the housing is 9 feet 6 inches above the bed. Altogether the planer contains 13,500 cubic feet of concrete and 34,000 pounds of reinforcing steel. The total weight of each machine is 1,600,000 pounds. Work was started on the foundaitons of the two planers on December 24th, and on March 9th the first one was in operation. This is remarkably quick time particularly when we consider the severe nature of the winter. The work was started in the shelter of an enormous tent and operations were carried on night and day until the work was brought to a successful conclusion.

Engineering Council.—Under this name there has been formed a new general engineering organization which seems to fill a very real gap. It is defined as an organization of the national technical societies of America created to provide for consideration of matters of common concern to engineers, as well as those of public welfare in which the profession is interested, in order that united action may be possible. It is planned that all the national engineering bodies and technical societies shall become affiliated, thus making Engineering Council truly representative of the hundred thousand engineers in all branches of the profession throughout the United States. It is hoped that a sense of solidarity will be fostered throughout all divisions of the profession in all parts of the country; that effective coöperation between the various branches will be improved; that a scheme may be developed for publicity of a high order that will make engineers and engineering more comprehensible to the people of the country. A most important service is the standardization of definitions, methods, requirements and tests for all varieties of engineering work. Attention is planned for the methods of conferring engineering degrees such as are in vogue in our colleges. It has become evident that though numerous engineering societies are occupying limited fields efficiently, and although some of these fields are extensive, there are large sectors of the domain of the engineer which are either weakly held, or usurped by others. To this state of affairs Engineering Council is to address itself. Already good service has been rendered in connection with war activities, although the Council has yet to pass its birthday. Headquarters are in the Engineering Societies Building in New York.

Science

A New Disease.—A disease new to science and provisionally called "X" has broken out in the west and northwest of New South Wales and has already caused a number of deaths. The symptoms somewhat resemble those of cerebro-spinal meningitis but it differs pathologically from that disease and in some respects is somewhat akin to pneumonia.

Phonograph Records of Earthquake Sounds.—Mr. F. A. Perret, volcanologist of the Carnegie Geophysical Laboratory, reports that he has nearly perfected apparatus for recording upon wax cylinders the subranean sounds of earthquakes. The ordinary commercial cylinders are unsuitable for this delicate work, and accordingly the laboratory has secured a supply of cylinders of the old, pure wax type. The microphone used in this connection has also been greatly improved, and a perfect little portable field outfit weighing less than pound has been evolved.

Public Health Service Needs Doctors.—The Surgeon-General of the U. S. Public Health Service announces that the service is in urgent need of additional medical officers for field duty in connection with the sanitation of numerous civil sanitary districts. The salaries offered vary from $1,800 to $2,500 per annum, according to qualifications and experience of appointees. Men physically disqualified for the Medical Reserve Corps are eligible for these positions provided they are not suffering from complaints that would seriously interfere with the performance of their duties.

Coal and Concrete.—In the summer of 1915 a concrete floor was laid in the storage bins of a Massachusetts coal yard. On most of this floor anthracite has been stored continuously since the date mentioned, and this part of the floor is in first class condition today. But on a small section of the floor bituminous was stored; and in the spring of 1914, after being so used for nine months, this part of the concrete was found to be so decomposed as to be worthless. It was as soft as clay for a considerable depth. This phenomenon was attributed by the owners to chemical action set up by the soft coal or some of its constituents; and they have brought it to our attention in view of its very direct bearing upon the subject of concrete ships.

A Magnetic Survey of the Air.—An interesting new field of research, to which the practical requirements of aeronautics will doubtless lend importance, has been suggested by Dr. L. A. Bauer; viz., a magnetic survey of the air analogous to those which have been made on land and sea. The data of such a survey will be needed by every air pilot who steers by compass. Investigations of the change of the earth's magnetic field with altitude were made in balloons by Gay Lussac and Biot in 1804, and again, half a century later, by Glaisher. However, says Dr. Bauer, the available observations to date do not possess the requisite refinement, and it is to be hoped that some day a non-magnetic airship and the necessary instrumental appliances will be available for conducting a magnetic survey of the atmosphere similar to that which has been carried out over the oceans by the non-magnetic ship "Carnegie."

Hereditary Traits of Naval Men.—Dr. C. B. Davenport and Miss M. T. Scudder have recently made an analysis of the juvenile and family history of naval officers representing 65 families and including more than 100 officers of various grades. The result has been the formulation of a new method which might be used in the selection of officers for the Navy; viz., the consideration of the facts of juvenile promise and family history. Certain traits of childhood and heredity are found to characterize potential officers of various types; including fighters (such as Nelson, Farragut, Porter and Cushing), naval explorers (such as Sir John Franklin, McClintock and Wilkes), naval inventors (like Dahlgren), etc. The factors for nomadic and adventurous traits usually come from the maternal germplasm only, though, as young naval officers often marry young women of naval stock, the traits may be shown on both sides of the family.

Petroleum Supply of the United States.—The United States produces about two-thirds of the world's output of crude petroleum, and has produced about 2,750,000,000 barrels since the first oil well was drilled in 1859. Our future supply, according to careful estimates of geologists, amounts to about 7,402,000,000 barrels, which would last only about twenty-five years at the present rate of consumption. In view of these figures, the Bureau of Mines urges radical economy in the use of this valuable substance. The history of our oil fields is a history of incredible waste and carelessness. Fields have been abandoned while a large part of the oil was still in the ground. Water has been let into the oil sands, ruining areas that should have produced hundreds of thousands of barrels of oil. A large part of our artificial gas is made from petroleum because it is, at present, cheaper than coal; but in the long run this is an extravagance, since our coal supply is probably adequate for centuries to come. The Bureau declares that petroleum should not be used in any way to compete with coal, when the oil supply is so limited.

Industrial Efficiency

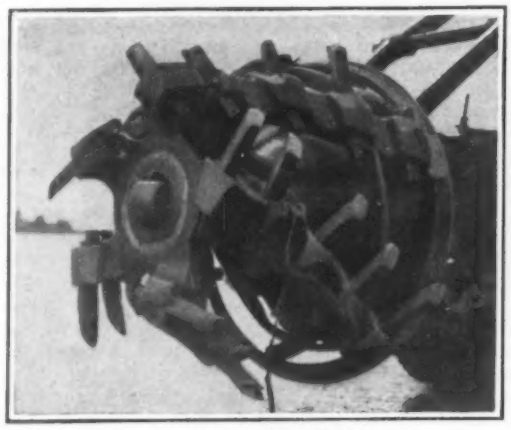
Our Women Also Serve.—While in the larger cities their work is not so noticeable, in the smaller centers of population our women are slowly but surely taking over the work of the men who are now in the Army, Navy and other Government service. So far, our women workers have not taken over the heavier classes of work found in manufacturing plants because there are still ample numbers of men available. However, in plants where there is much light manufacturing women are to be found in profusion. In stores, hotels and even in street cars, American women are taking the places of men with the colors. Women soda-water dispensers and elevator runners are now quite common in most cities.

Battery System of Machine Work.—That the requirements of our wartime Army and Navy are becoming increasingly heavy is evident in most industrial centers. In fact, many manufacturers are finding it most difficult to obtain sufficient help to maintain their normal production, and many more have already been obliged to reduce their production. A manufacturer of bicycles and firearms located at Fitchburg, Mass., confronted like many others with the labor shortage problem, has succeeded in ameliorating the present condition by extending the battery system of production long since used in his plant. The battery system means merely this: Instead of having an operator give all of his attention to one machine doing a certain piece of work, this manufacturer has four machines on the average for each operator in such departments where this system is practical. The machines are so arranged that the operator can start one going, then give his attention to the second, then the third and finally the fourth, coming back to the first in time to take off the piece being machined and place a new piece. Not only does this system increase an employee's output four-fold, but it makes for better work since the machine does its work automatically and the human element is practically eliminated.

Old Tracing Cloth for Surgical Dressings.—American manufacturers, architects, and all draftsmen are called upon to render an important service to their country. When the workman has finished with the piece of cotton or linen cloth used in his trade, it is flung aside to be destroyed. The Red Cross is asking now for that discarded material. All over the country thousands of women are earnestly engaged in the manufacture of surgical dressings to be used in the hospitals for our wounded soldiers and sailors. The problem of getting enough white goods for this work is enormous. As long as the war goes on the work must go on if we are to live up to the humanitarian ideals typified to the world today by the Red Cross. Two kinds of cloth are available—draftsman's tracing cloth and old linen and cotton articles to be donated from private households and, often in large quantities, from hotels. These can be easily collected and handled by the modern laundries, which have now been called upon to perform this work for the Red Cross. With their facilities for collecting, washing, sterilizing and delivering to the local chapters, the laundries are in a position to perform an invaluable service and the least that other trades can do, is to help them in every way. If any manufacturer, architect, or draftsman will go to the slight trouble of calling up either the local Laundry Owners Association or one of the large laundries of his city, he will find them only too glad to send for such cloth as he can make it possible to give them.

German Toy Industry is showing the effects of over three years of war, says the *Board of Trade Journal* in quoting the *Berliner Tageblatt*. Simplicity is the rule in toy shops at present. Wood, which was formerly used only for the cheaper sorts of toys, is now the chief material employed. The manufacture of new dolls is becoming impossible through lack of flour (used, with cement, in making the bodies). Wax, which is employed for the heads of the better class dolls, is almost unobtainable; the same is true of the stuffs and lace used for making dolls' shoes, hats, dresses, stockings, etc. These are only obtainable at prices four times higher than before the war, consequently the prices of toys are higher. The simple, cheap toys that formerly could be bought in the stores or from street venders for 10 pfennigs now cost 20 pfennigs or more. Jumping jacks of paper and cheap picture books can no longer be had except where old supplies are still in stock. Metal toys are few in number. The pretty toy trains, magic lanterns, etc., which used to be so common, have been turned out only by those manufacturers who were also engaged in munition work and so commanded supplies of the necessary materials. Toys which were intended for export, but which could not be shipped owing to the war, make a welcome addition to the supply for home consumption, large quantities of the better class of toys being thus put at the service of the home dealer. Great difficulties stand in the way of conveyance of all these lines of toys from the maker to the large towns, and only after long delay do toys reach the retailer.

The delivery end of the suction pipe



Tooth cutter for hard digging

What the dredge brings up

Modern Suction Dredging

Pumping No Longer Restricted to Liquids

By Charles Evan Fowler, C. E.

THE method of handling dredging work by the hydraulic or suction process had its real beginning in the United States, when the various devices necessary for the successful operation of centrifugal pump dredges were patented by Alonzo P. Bowers, who, however, as the sequel proved, had originated only a portion of them. When the writer went to the far northwest in 1900 to take charge of work being carried out under these patents by the late George W. Catt, Member American Society of Civil Engineers, machines of this type had been perfected to a degree of practicability which was then considered marvelous, and which warranted the writer in taking contracts for the dredging out of waterways and the filling in to above high tide of lands in the tide flat area at Seattle, Wash., amounting to over 1,200 acres in extent, and requiring tens of millions of cubic yards of sand for the new land, which was to be from five to twenty-five feet above the bottom of the water in which it was being laid down.

The essential features of a suction dredge are a hull carrying the machinery, consisting of boilers; compound condensing engines with auxiliaries, to operate the huge centrigugal dredging pump; engines for operating the digging machinery and to control the movements of the dredge.

The stern of the dredge is provided with tall masts for raising and lowering the spuds, which are used as the pivot about which the dredge swings, and for walking the dredge ahead in the cut. The bow of the dredge carries a huge steel ladder of from sixty to seventy feet in length, which is hinged to the dredge for dropping the cutter to the bottom to agitate or actually cut loose hard material to be excavated. The revolving cutter is one of the vital parts of the dredge, and it is operated by a shaft running the length of the ladder, which also carries the suction pipe.

The form of the cutter was, and is yet, the most disputed feature of design, as while almost any kind of a cutter would stir up mud, there was necessary a really efficient device for loosening packed sand or gravel, and for cutting the loose clay or harder materials. The various types of cutters were most of them of the inward delivery type, which dropped the material in front of the end of the suction pipe, but some of the forms were and still are very ineffective and only dig and deliver a percentage of the amount of material the pump would handle. Within the last few years a patent tooth cutter has come into use, which will dig hard pan, cemented gravel and the softer and more shelly type of rock. The teeth must be of the proper form and distribution, and must be made from a high grade of tool or projectile steel to stand the wear for even a matter of hours in very hard digging. The power required for operating such a cutter must be compound engine, or else a motor, of from 200 to 600 horse-power, geared to operate the cutter the proper number of revolutions per minute, usually from twelve to sixteen. The material when it passes through the cutter must be distributed by the proper devices in front of the suction pipe.

Twenty years ago the ordinary dredge was a 20-inch machine, with both the suction and discharge pipe of this size, and with a special form of dredging or sand pump, with about 400 to 500 horse-power. These machines were designed along the lines of a centrifugal pumping plant for water, except that means were used to line the pump to care for wear by sand and gravel. Only in recent years have the companies and engineers having to deal with such work come to realize fully that to pump solids with from 2.0 to 3.0 specific gravity, large power is needed; and a 24-inch machine like the one shown will have from 1,200 to 2,000 horse-power, which will give a pressure on the discharge pipe of from fifty to one hundred pounds per square inch, and afford the necessary velocity in the line to keep heavy boulders and rock moving.

The pumps in use for big dredges for many years were of rectangular cross-section, with steel or cast-iron liners, the pump and runner (or piston) being made of cast iron. Strange as it may seem, the best pumps of this type were made at Sutter Creek, Cal., where gold was discovered, by a practical man named Knight, who operated a foundry and machine shop.

The modern pump of 24-inch suction and discharge, often over ten feet in diameter, is made from cast steel, as is also the runner, which is speeded up to from 250 to 300 revolutions per minute. The runner is of the closed type with from two to six vanes according to the service demanded, and having plenty of clearance to pass obstructions, such as boulders, rocks, pieces of timber, scrap iron and all sorts of debris. Recently engineers have become aware that the angle of the vanes is an important factor and very often it is found good engineering to make the angle with the tangent very small, depending, of course, upon the work to be done; and experiments are being arranged to determine the vital features of their design, as well as other devices.

The engines used for operating dredging pumps of large capacity are usually of the four-cylinder, triple-expansion condensing type, using steam at about 200 pounds pressure from boilers of ample capacity. Steam turbines are beginning to be used but must be of a type especially designed for such service, as the standard marine turbine will not usually prove satisfactory, owing to the variable nature of the service and the liability to sudden shock. When motors are used they should be of a variable speed type, especially designed for the service, and where low-priced hydro-electric power is used, they are very economical.

The suction pipe of the dredge enters

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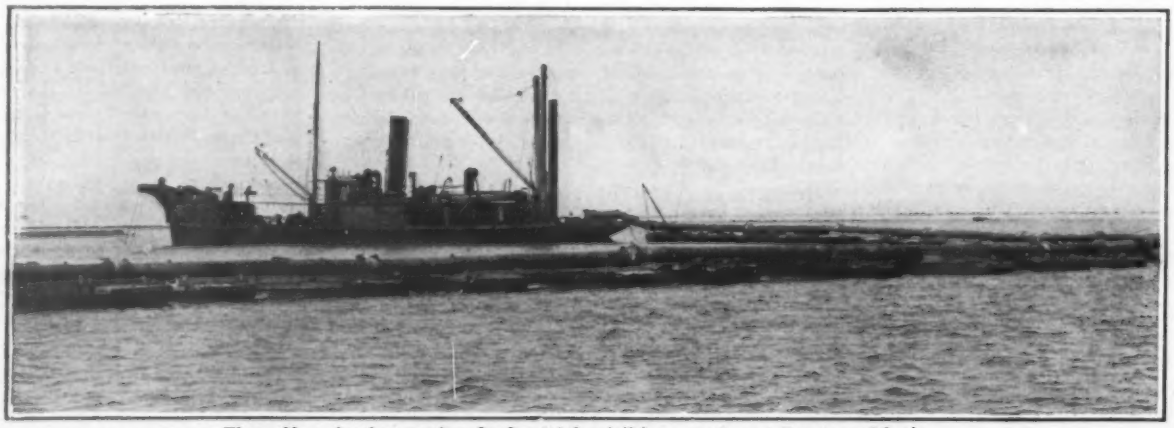

The self-navigating suction dredge "Atlantic" in operation at Frontera, Mexico

Big suction dredge at work in the Galveston-Houston canal

Floors Made of Wood Blocks

COMBINING all of the essential elements of a good, general purpose, heavy service floor, creosoted wood block floors are becoming quite common Although the first cost of this wood block construction is higher than some other types, maintenance cost is almost negligible by comparison because of its great durability, while it makes many economies possible in plant operation

The resistance of wood block floors to wear is astonishing. Under the extremes of load and heavy traffic the ends of the wood fiber iron out smoothly to form a surface that grows stronger and more compact with use; a surface which is claimed to be permanently level and does not abrade, crack, crumble, chip or corrugate. With all this it is the easiest floor to repair, should repairs be necessary. It is firm and hard enough to offer small rolling resistance, yet never becomes slippery or loses its resiliency. It absorbs vibration; is a non-conductor of heat and cold; is comparatively noiseless and does not originate dust. It is waterproof, decay-proof and vermin proof.

Most interesting of all is the fact that wood block floors of the better kind resist high temperature extraordinarily well, and char very slightly even when directly subjected to fire. When set on a concrete base a wood block floor is exceedingly difficult to burn. There have been instances in foundry operation of crucibles overturned and molten metal poured upon the blocks, which showed but little damage. In the fire which completely destroyed the P. & R. Pier No. 29 at Philadelphia, Pa., the structural steel was twisted and warped, and after the wreckage was cleared away the creosoted block floor was found to be damaged very little, suffering only a slight charring on the surface. These blocks were taken up, scraped and relaid and are still giving excellent satisfaction—a practical demonstration of their freedom from damage by fire.

A shop or factory floor with all these physical advantages must promote higher efficiency both as regards employees and mechanical equipment. Being free from both cold and dampness, noiseless and easily kept clean, working conditions are improved. The absence of dust, and the distinctly antiseptic nature of the creosote preservative, are real factors in securing better health among the workmen.

Owing to the particularly resilient nature of its surface, the wood block floor is comfortable to work on and labor is spared much of the fatigue attributable to floors composed of harder materials. This characteristic also helps to keep tools from being blunted or castings broken that may be allowed to fall. Then, too, the absence of dust saves bearings and other delicate parts of expensive machines from injury. Truck labor is greatly reduced and also the accident hazard is low with a floor that is not broken, uneven or patched and that never becomes slippery.

The absorption of vibration is another valuable point in favor of wood block floors, as it enables greater accuracy to be obtained in the operation of precision tools. Again, the use of such small units as wood blocks makes it a simple matter to take up any section of the floor to put down pipes, conduits or rails, or the foundations of heavy machinery, and to relay it quickly again without any alteration of the floor level. Light machinery can be lag-screwed directly to the blocks, perfect stability being insured by the strength of the binding.

Long-leaf yellow pine has been selected for the better grade of wood block flooring, for the reason that, on the authority of the American Railway Engineering Association, it exerts the greatest resistance to end compression because of the extreme density of its fiber and high proportion of summer wood, in which short-leaf pine is

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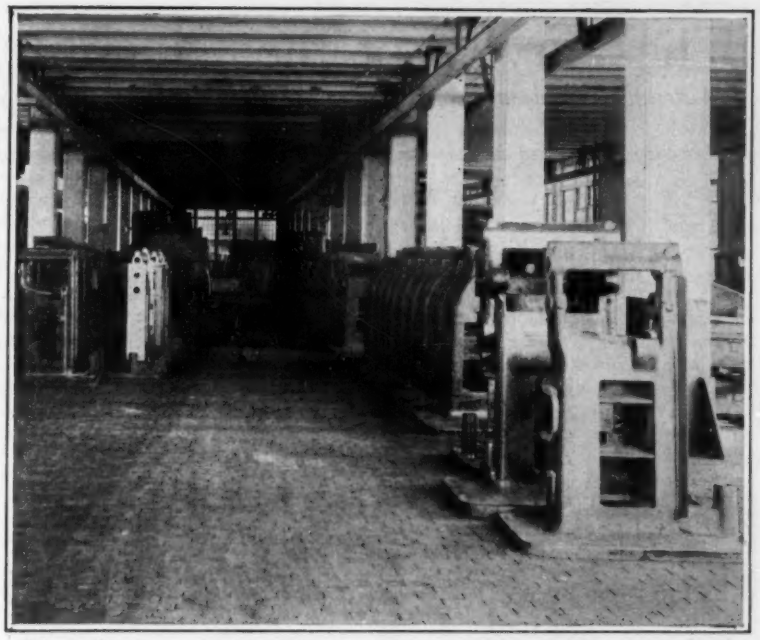

Many advantages are claimed for a floor of creosoted wood blocks, even when subjected to the heaviest kind of service

Digging Holes With a Pile Driver

THE first work of the engineer charged with the erection of a bridge or of the architect who plans a building of any size is to examine with care the site of the future structure. When the project is but a modest one, he simply digs an open well along the sides of which, boarded up roughly as he proceeds, he may study the nature of the successive strata encountered. But when it is such a matter as the setting up of a huge factory upon the uncertain ground which so often underlies our great cities, or upon the sands or the mud met along the banks of our rivers, it becomes necessary to carry out this business of subterranean sounding by means of special apparatus which brings to the surface samples of the various layers encountered in boring. Then, once the general nature of the spot is known, the resistance of each stratum must be determined in order to know the weight which it will safely support.

At this juncture the problem of foundations presents itself. To this problem, in the course of the past few years, several solutions have been proposed. One of the most elegant methods, and at the same time one of the least known—in spite of a use which has extended from France and Belgium to such a far-away region as Siam—is that developed not long ago by the engineer Louis Dulac. This process consists, in its most general terms, in consolidating the ground by blows from a weight, without removing any material whatever. The resulting holes are then filled with stones or some aggregated material, likewise under pressure; and by making the borings sufficiently close, there are thus obtained a series of subterranean columns well fixed in the earth. Since on the one hand none of the surrounding earth has been taken out, while on the other a certain amount of hard material is added to fill the holes, the soil is tightly packed about the columns, and the foundation as a whole forms an area of demonstrated solidity and resistance.

To bore the holes and pack them mechanically a crane—or perhaps it might better be characterized as a modified pile driver—is used. It is mounted on a carriage some twenty yards high, and serves alike for boring and packing, and even, when necessity arises, for driving piles.

This machine, illustrated herewith, consists essentially of a clutch which travels up and down in a vertical chute, being controlled by a powerful windlass. In connection

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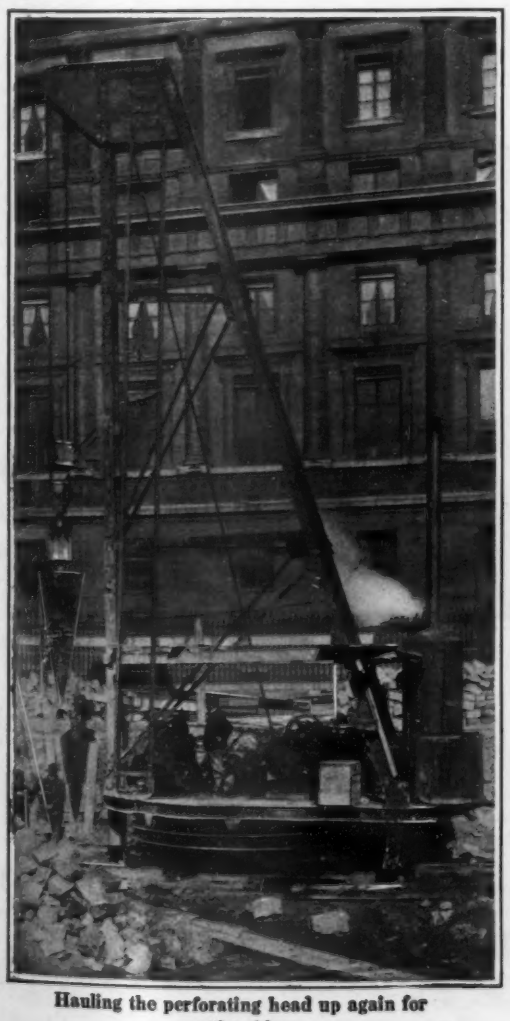
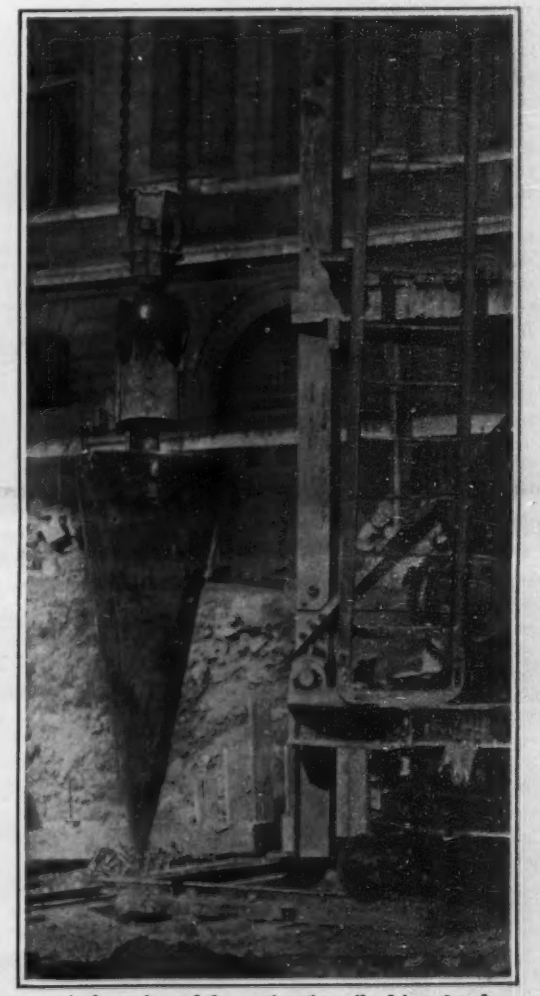


Hauling the perforating head up again for another blow

The clutch released by contact with the ring, the head falls



A close view of the perforating pile driver head, with the clutch mechanism

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Conducted by H. E. HOWE, Chemical Engineer

Sugar Cane Paper for Fighting Weeds

IF you can shift your geographical attention from Europe to the tropics for a moment you may remember that in those countries where sugar cane grows, the soil is rich, the climate warm, the rainfall heavy and the weeds vigorous. They literally spring up over night. Your war garden experience has emphasized that weeds retard or even choke out vegetation and sugar cane is no exception.

The expense of heavy hoeing or diminished yields of cane sometimes makes the difference between a profitable and an unprofitable year, and so Mr. C. F. Eckart of a Hawaiian sugar company began experiments looking to weed control. Weeds between the cane rows could be controlled by spraying, after which followed a demonstration that the weeds could be smothered by strips of paper, asphalt impregnated to withstand weather and handling.

Knowing that cane shoots are tightly rolled up, sharp pointed and spear like, Mr. Eckart conceived the idea of using paper over the cane rows, being careful to have the paper of the proper construction to hold the weeds beneath, while the cane, by gentle pressure, could puncture the covering. Considerable acreages have been under experiment and several interesting developments have taken place.

The paper in yard widths is placed over the rows and kept there by bamboo pegs, stones and field litter. As the cane shoots come up those striking the paper at or near right angles, puncture the covering and grow vigorously. The other shoots make tent-like elevations at which points the paper is slit after five or six weeks during which time the cane does not suffer although the less hardy weeds are exterminated.

Beneath the paper moisture is conserved and the temperature is from three degrees to five degrees Fahrenheit warmer than above it, so that under such humid conditions the cane growth is abnormally rapid, while at the same time all weed seeds germinate. The weeds spring up, blanched in the dark, only to smother, since their soft tops provide no means for breaking through the paper. By the time the paper must be slit, the weeds are no more and as the paper disintegrates the cane is so far advanced as to command the situation.

This method effects a labor saving of from fifty per cent to seventy per cent and an increase of some ten tons of cane per acre equivalent to more than a ton of raw sugar.

There is a second chapter to this story affording an unusual example of waste utilization. The paper required in row mulching, as the use of paper on cane rows is called, had to be brought long distances, while a fibrous material, bagasse, or the cane from which the sugar has been pressed is produced on the spot in excess of fuel requirements. To make a suitable paper from this bagasse presented a new problem; for while many good papers have been made from this raw material, none has had the characteristics required for this special use.

The problem has been solved by an American chemical research company and a mill is being erected in the Hawaiian plantation which now supplies the paper, exactly suited to the requirements, from the bagasse. This is accomplished with a saving exceeding fifty per cent of the cost of the paper previously used.

Summed up, the achievement is the utilization of a waste material to found a new industry, the product of which reduces the cost of growing sugar cane and at the same time produces an additional ton of raw sugar on each acre of the plantation in question. Real Hooverizing; isn't it?

Courtesy, The Little Journal

Fighting weeds with paper

Sugar cane sprouts through while the weeds are suppressed

The World's Rubber

WHEN automobile tires are quoted at $500 each, in the Scandinavian countries, and the central powers exert every effort to obtain rubber, we may consider our own increased use and decide to look into things just a little.

Of the three great classes, wild, plantation, and synthetic, plantation rubber supplies by far the largest and most dependable quantity. The majority of the plantations are in the far east where nearly 2,000,000 acres are planted to rubber in the Malay Peninsula, Burma, India, Ceylon, Borneo, Cochin-China, New Guinea and the Dutch East Indies. Areas are also planted in Africa and the Philippines. Since about five years must elapse between the time of planting and the commencement of tapping something may be foretold regarding rubber during the next few years. That is, any acreage planted during 1918 would have little affect upon the market prior to 1924.

If then we consider the probable yield per acre we may gain an idea of the resources for our immediate supply of natural rubber. In 1916, the world production from all sources was, on a washed and dried basis 427,250,000 pounds of which 267,000,000 came to the United States and the actual yield of plantation rubber from the territory above outlined is reported as 295,680,000 pounds. Many acres had just begun to bear so that at least 492,800,000 was expected for 1917 or an average of 246 pounds per acre. By the time the entire acreage now planted is in full bearing, a yield of 400 pounds per acre or about 770,000,000 per annum is anticipated. This is no doubt too high an estimate, as no allowance has been made for failures from any cause in any areas.

There is little reason to expect any greater production of plantation rubber for another five years and we may wonder therefore whether the greatly increased demand for rubber which has come with the war may not again encourage synthetic rubber at least temporarily. While we hope the war demands may soon decrease and disappear, it seems obvious that an unusually heavy demand may continue, due to a natural rapid increase in the use of rubber. The orient is affording new markets and rikishas are frequently seen equipped with rubber tires. Improved roads are attracting the automobile, and rubber footwear is growing in popularity where the concentration of wearers is greatest. Meanwhile the stocks of certain Dutch Rubber companies have advanced, for example, from 94 in 1914 to 199 in 1915, and 259 in 1916, or from 200 in 1914, to 350 in 1915, and 418 in 1916.

Synthetic rubber seems to many an achievement of more scientific than commercial interest, since rubber can be produced so easily in its natural habitat, and many acres now unplanted are capable of being brought to bear.

There has been some argument as to whether synthetic rubber was first produced in England or Germany but, normally, both the English and German plants had handicaps in the form of undesirable by-products.

Among the methods for making synthetic rubber those of interest to Americans include that based on the use of aldehydes and ethyl alcohol to be produced in our idle distilleries, and another starting with acetone. Acetone can be produced by fermentation from starch or more interesting still, from acetylene derived from calcium carbide.

America is well placed for the manufacture of this commodity which is the starting point in the chain acetylene, acetaldehyde, acetic acid, acetone, pinacone, dipropylene rubber. But there are many factors in the equation, as Dr. Dannerth has indicated and whether synthetic rubber will ever become established in this country depends, among other things, upon the minimum price of natural rubber in the United States; whether the demand greatly outruns the supply; success in finding profitable uses for by-products of synthetic rubber processes; ability to produce sufficient raw materials cheaply; improvements in the apparatus employed in manufacture and the availability of suitably trained chemists and engineers.

It does seem that in rubber nature has for the moment one speciality at least, which the laboratory may find some difficulty in wresting from her on a commercial scale and that there is little in prospect to assure much lower prices for rubber products for a few years at least.

Courtesy, The Little Journal

Cane 4½ months old. That at the left was grown in the natural way; that at the right was aided with paper

The man is standing at about the same distance from the camera in each picture

The Peanut Ascendant

THOSE who have a habit of belittling a thing by comparing it to a peanut must seek another simile. To manage a real peanut stand is becoming an undertaking of some moment. The *Weekly Bulletin*, organ of the Food Administration tells us that peanut hay is useful in feeding livestock and that the hulls may be used as fuel, fertilizer and in the tin plate industry. Peanut meats furnish cake and meal for flour, live stock feeds, fertilizer and dyestuffs. Peanut oil expressed from the meats is used in cooking oil, salad oil, lard compounds, sardine packing, olive setting, oleomargarin, sweet oil substitute, medical emulsions, cosmetics, soap, kid glove and silk manufacture and miners lamps.

Peanut oil foots enter into washing powder, glycerine, nitroglycerine, black grease, soap, candle pitch, putty, roofing composition, insulation, linoleums, oilcloth, waterproofing, artificial leather, cheap paint base and fulling ware.

Correspondence

The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.

Shotguns for our Aviators

To the Editor of the SCIENTIFIC AMERICAN:

I note in the SCIENTIFIC AMERICAN of February 2d, 1918, an article headed "Shotguns for our Aviators." I have long wondered why someone of Mr. Crossman's ability has not before this put the matter up to the War Department. Shotguns for instance in aviation should be very valuable, if the statements made that they sometimes fight wing to wing, or come to close quarters, be anywhere near correct.

I have been wondering, however, if Mr. Crossman has considered carefully the question of the automatic shotgun. My experience with this arm is that it is not possible to keep it from getting out of order repeatedly and in very short time. Therefore, it would seem to me that for army use an automatic would be a little dangerous.

Have you considered a 10-gage double barrel shotgun? They could be loaded very quickly and I think that all of the trials shown indicate that the bigger your bore the further a shotgun will carry with efficiency. In other words, a 10 will outshoot a 12 and make a better target and in turn a 12 will outshoot a 16 and a 16 will in turn outshoot a 20.

I have seen a 10-gage loaded with 12 pistol balls and deer killed at apparently over one hundred yards, rough measurement. The pistol balls chamber well and make a good target.

I have been on the frontier all my life and have seen many different gun fights and results from the same and as you say in your article a shotgun is a very deadly weapon.

For night work in the trenches I cannot see how a rifle can be in its class; at 100 yards it would scatter enough to get several men with a target and a good shotgun man would be able to load and shoot a double barrel at an advancing column every 10 yards with deadly execution.

In this hand grenade business a shotgun in the hands of a quail shot would nail every grenade rising above the German trench and kick it back, say loaded with No. 4 or 5 shot. A quail shot would hit those grenades within five yards of the throwing trench every time and probably explode the bomb by hitting it, or if not, stopping it before it got into the trench at which it was aimed. This, you will perceive, is rather a sporting proposition—hit your bomb or get killed. The most hardened and blasé wing shooter ought to get a thrill out of business of that sort.

Ten-gage shotguns could be manufactured very quickly and cheaply.

M. H.

San Francisco, Cal.

To the Editor of the SCIENTIFIC AMERICAN:

I have read with interest an article in a recent number of the SCIENTIFIC AMERICAN, proposing to arm aviators with repeating shotguns and buckshot cartridges instead of machine guns. Would it be practicable to use a large caliber, smooth-bore machinegun for this purpose? Or if not, could not an autoloading shotgun be devised with a drum or clip magazine, instead of the present slow-loading, small-capacity tubular type? In case the machine-gun idea would not work, it would probably be well to have the shotgun of as large a gage as could be handled: ten- or even eight-gage instead of the usual 12-gage. I shall be greatly interested to see any further development of the use of shotguns in hunting German "doves."

PAUL MCANTHONY.

San Diego, Cal.

To the Editor of the SCIENTIFIC AMERICAN:

Referring to the article "Shotguns for Our Aviators" by Edward C. Crossman, in the February 2d, 1918, issue of SCIENTIFIC AMERICAN. Would say that in the latter part of the summer of 1917, Mr. James R. Henderson and I wrote the War Department, offering the following suggestions for a shotgun to be used in the front line trenches and by aviators.

Our idea was, build shotguns of very large caliber, possibly using a shell the size of a one-pound rapid-fire gun shell, the same holding possibly one hundred, more or less, ordinary buckshot. This gun would necessarily have to be mounted rigidly on the fuselage, and, we thought, could operate on the machine gun principle, or as one-pound rapid-fire guns operate.

I imagine a rapid-fire gun could be devised, on the machine-gun principle, to handle round bal', of great weight.

Neither Mr. Henderson nor I is an expert in gunnery, but as Mr. Crossman's article is the first I have seen on the subject, I am naturally interested. We trust that some inventor will turn his attention to the development of a heavy caliber gun of the shotgun type at an early date, as the apparent advantage of this style gun is evident.

HARRY B. MARSH.

Carney's Point, N. J.

Cast Rock Salt

To the Editor of the SCIENTIFIC AMERICAN:

Some months ago you published an article upon making solid blocks of salt by compression, to be used in lieu of rock salt. Perhaps you will be interested in another type of artificial rock salt which I have discovered.

If common salt is heated to a clear red, it melts without change and may be cast into blocks which may be used in place of rock salt. This melting may be conducted in a clay or a cast iron crucible heated in a wind furnace, and if the melted salt is poured into a thin iron hemispherical cup or dish, and allowed to cool slowly, the block of salt will be compact and moderately strong. When using a six-inch cup, a one-pound block will be of convenient form and size to place in a feeding trough.

In the Atlantic states, usually the supply of salt is obtained from salt wells, but the rock salt must be brought from the west or from England at a considerable increase of cost. It may therefore often be advantageous to produce it by this simple and cheap method.

I do not propose to patent this, but wish to present it to the public.

F. P. DUNNINGTON.

University of Virginia.

American Machinery in Japan

To the Editor of the SCIENTIFIC AMERICAN:

In reference to Mr. Kinnosuke's article on "American Machinery in Japan," I have a brother-in-law who returned from the Orient last year after traveling there a year in the interests of one of the largest scale and machinery concerns in the world. He is now in South America or I feel sure he would answer the article himself.

He says that the Japanese have taken their scale apart, made patterns, and duplicated every part, even to the name and trade-mark on the castings and thus practically monopolized the Chinese trade, because the Chinese won't buy a scale with any other name on it.

When taken into the courts to answer infringement proceedings the defendants replied that they couldn't sell the scales without the name on them, which in Japan seems to be a legitimate excuse.

There seems to be very little originality among them. Of course we have to give them credit for being quick and grasping the customs and advantages of civilization; but if somebody had not shown them they would still be where they were sixty years ago.

A salesman for a packing concern who was traveling with my brother was taken before a purchasing board of officials who tried to bluff him into telling them the composition of his materials.

I guess the only reason they want American machinery is that they haven't facilities for duplicating what they have.

L. W. SMITH.

Newark, N. J.

What One Concern Did to Conserve Fuel

IN accordance with the request of the fuel committee, a manufacturing concern of Worcester, Mass., took steps to save coal during the recent severe shortage. As a result of these various steps the concern effected an economy of not less than 15 per cent in the use of fuel, although on account of the very unusual winter conditions it has been found quite impossible to ascertain the exact amount.

The first step in this direction was the forming of a suitable organization for carrying on the fuel conservation policy of the concern; and for this there was appointed from the foremen and executives a so-called Shop Fuel Commission. A little later a Shop Fuel Administrator was appointed, whose business it was to follow up the various methods inaugurated, to see that the best results were accomplished therefrom, and also to see that continued interest was maintained.

The several points featured in the fuel conservation program of the Worcester concern can be listed under four headings:

a. Improvement in boiler house practice.
b. Improvement in use of power.
c. Improvement in use of heat.
d. Improvement in use of lights.

As regards the first of these headings, improvement in boiler house practice, the following things were done:

The temperature of the feed water was raised by the return of condensation. Success was attained in raising the temperature of the feed water entering the boilers from 180 degrees F. to 200 degrees F. The burning of all wood scraps and shavings produced in the plant, amounting to five or six tons a day, served to save coal. A better boiler room practice was inaugurated by putting observers in the boiler rooms day and night for several days and nights in order to determine the rate and efficiency of firing. The usage of coal by half-hour periods, as fired, was recorded for many days and plotted, from which was evloved a better practice as to uniform and more economical firing. The weighing of all coal supplied to the boiler room and only allowing a certain amount of fuel to be used in definite periods also served to good purpose. The remainder of the coal was locked up, so that the fireman had to be economical in the use of the portion that was issued to him. Lastly, pinhole grates and under-grate blowers were installed so as to allow the use of screenings. While the screenings have not been of very high grade, there have been many days when, through the use of these, the concern has used practically no soft coal whatsoever. In fact, through the use of these screenings it was possible to conserve appreciably the soft coal supply. The screenings are constantly being analyzed, and the present practice is to discard all screenings that show an unusual per cent of dirt and ash.

Now under the heading of improvement in use of power, the following was done:

Under the direction of the Shop Fuel Commission, the number of idle machines was observed by an inspector, on which belts had not been thrown off. Vigorous action with the foremen resulted in the number of machines running idle and wasting power being reduced to an absolute minimum. This was accomplished principally by the installation of hooks to permit the hanging of idle belts. Then there was the studying of the load on every motor throughout the shop. Where the load was not sufficient to get the maximum efficiency from the machine, conditions were changed to make this possible. All cases of motors working underloaded were eliminated. All overtime that involved the inefficient operation of machinery was stopped. The use of large elevators was restricted to actual needs. This resulted in the elimination of several hundred trips throughout the day. Finally, the entire requirements of power had been purchased from the local electric light company up to last December, obliging the concern to use live steam for heating. Since the need of fuel conservation became critical, however, the load of the electric light company was reduced at their request some 40 per cent, by operating the concern's own engines and using only the exhaust steam for heating. It is claimed that this was accomplished with practically no increase in the use of fuel.

Under the third heading, namely, improvements in use of heat, these were the things done:

Only exhaust steam was used. Under the Shop Fuel Commission a most thorough inspection was made of all doors, windows, transoms, etc., throughout the plant. These were promptly fixed up and every time the shop was shut down a designated committee was sent around the plant to see that all places were tightly closed up to keep out the cold. This feature alone, it is said, saved considerable in the amount of fuel necessary to heat up the plant after a shutdown, say, week ends. On all doors that opened to the outside, automatic door closers were installed where previously there were none, thus making sure that needless cooling down of the plant was reduced to a minimum. By the appointment of a special inspector the concern was able to cut off every day from twenty to fifty per cent of its heating surface. This was accomplished by listing the number of feet of heating pipe in the various departments and by having the inspector follow the sun, so to speak, in turning off the steam in various departments as the temperature rose in the morning. This saving has been very heavy, as it meant from 200,000 to 500,000 heating foot-hours per day. The concern has upwards of twenty acres of floor space and about twenty miles of pipe for heating. Last of all under this heading, all exposed steam piping was covered.

Under the heading of improvement in the use of lights, the following was done:

The saving in fuel in connection with the use of lights was large, to be sure. In the first place, the concern developed interest on the part of the foremen in connection with the problem, and actual inspection at various times of the day resulted in the cutting out of a large number of unnecessary lamps. Then, too, carbon lamps were replaced with tungsten lamps. The usage of carbon lights in this instance had been continued to use up a stock on hand, which practice was promptly discontinued when the order came to save fuel. Still another feature was the reducing of the wattage of lamps in places where heavy illumination seemed unnecessary. This resulted in a marked saving.

So successful has the Worcester concern been that it is quite likely that the fuel conservation program will be maintained even after the strenuous needs of today have passed away. The information given in the foregoing paragraphs are the result of a real study of the fuel saving question, and other concerns would do well to make use of some of the suggestions.

Velocity and Range of Guns

From the Black-Powder Muzzle-Loader to the Smokeless-Powder Rifle

By J. Bernard Walker

THE energy of projectiles varies as their weights and the squares of their velocities. If we double the weight, leaving the velocity the same, we secure twice the energy in the projectile; but if we double the velocity, leaving the weight the same, we secure four times the energy. Hence, the gunmaker, in his tireless endeavor to increase the power of artillery, has sought to increase velocity to the maximum degree compatible with the various conditions imposed upon him by the problem.

An Early High-Velocity Gun

One of the earliest attempts to secure very high muzzle velocity was that of A. S. Lyman of New York, the inventor of the Lyman Sight, which was widely used on the sporting rifles of his day. Somewhere about the year 1880, Lyman devised what he called an "accelerating gun," in which he aimed to secure a great increase in penetration and range by an unprecedented increase in the muzzle velocity. He built a 2½-inch gun which, when tried out against a 5-inch Whitworth gun, is said to have shown, at short ranges, a greater penetration.

Then Col. J. H. Haskell became associated with Lyman, and a new gun of the same general design was built in 1881, and was given a lengthy series of tests which attracted much attention. The SCIENTIFIC AMERICAN sent representatives to the trials, and published a sketch, made by its artist at the proving grounds, which is reproduced on this page.

This gun was of six-inch bore and measured 25 feet in length; that is to say, it had the amazing length, for those days, of 50 calibers—a caliber-length which is not surpassed by the high-velocity guns of the present day. Further particulars of the Lyman-Haskell gun will be found in the current issue of the SUPPLEMENT.

Gun with Five Powder Chambers

It was well understood that to secure great penetration and range, high velocity was necessary and that high velocity called for a large powder charge and high powder pressure. But the gunmakers of that day did not possess the superior gun steel that is available today, and hence it was necessary to keep the powder pressure within limits. In other words, Lyman and Haskell realized that in order to secure high velocity with low powder-pressure they must find a way to burn a large powder charge *progressively*.

So they decided to build a very long gun and provide it with five separate powder chambers, one at the breech and the other four progressively along the gun and below it. The shell weighed 150 pounds (a modern six-inch shell weighs 100 pounds) and the powder charge was 130 pounds. The small charge of powder at the breech served to start the shell, and it was believed that as the latter passed down the bore, uncovering the other four powder chambers, their contents would be successively ignited, and that their combined action would serve to maintain a high average pressure on the base of the shell until it left the muzzle.

Theory Right—Practice Wrong

The theory was correct; but it did not work out in this particular application—as will be seen from the fact that, in spite of the huge powder charge, the highest muzzle velocity obtained was only 1,700 feet per second. Just what was the trouble our article written at the time does not state, further than to say that it was surmised that the successive charges did not fire with regularity. An eyewitness tells us that, instantly following the first flash of the gun, there would often be one or even two subsidiary flashes, suggesting a belated firing of the powder pockets.

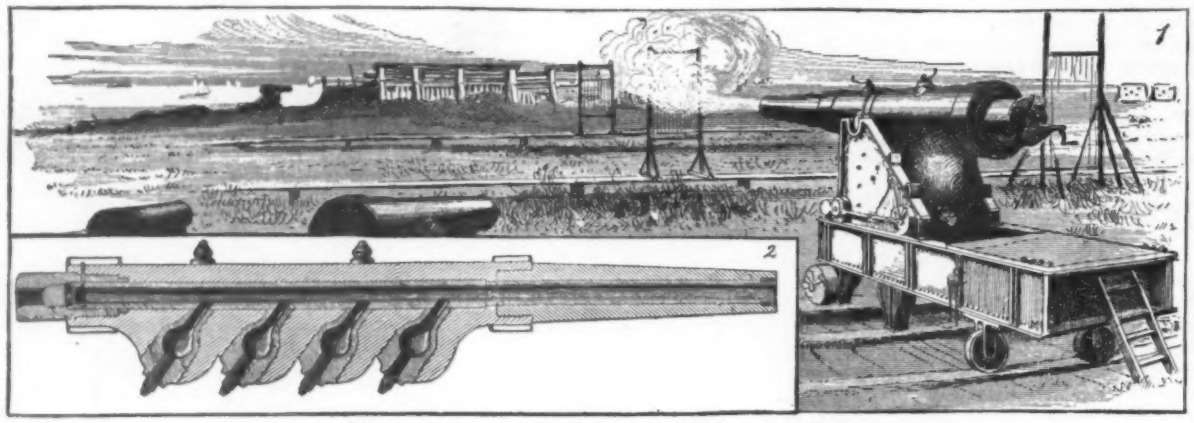


Fig. 1. The Lyman-Haskell, multi-charge gun of 1880

Lyman Tries Slow-Burning Powder

But Lyman was on the right track. He determined to use the whole charge in one enlarged powder chamber, and make a powder that would burn progressively. His progress is revealed in a patent (No. 321,374) issued to him June 30th, 1885, the drawings of which are reproduced herewith. The powder formed a cylindrical cartridge, and was to be "hard and dense, so that the fire cannot penetrate into it, but must burn only on its surfaces" and it was to be perforated by holes running through it longitudinally from end to end.

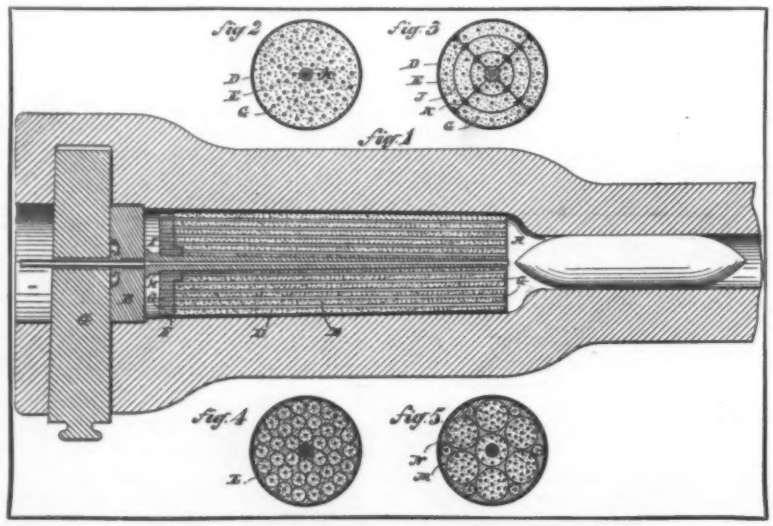


Fig. 2. Perforated cylindrical-grain powder of 1885

Said the patent: "To fire the cartridge, a flame is forced down the firing-tube and ignites the front end of the powder-cake and flashes back down the perforations in the powder-cake, igniting the surfaces of all the holes at the same instant. The fire-surfaces at this moment are comparatively small, and the pressure is correspondingly low; but as the burning proceeds in a radial direction, the holes in the powder-cake become constantly enlarged and the fire-area continuously increases, as also does the pressure upon the projectile, and the inertia of the projectile is gradually and slowly overcome. After the projectile has been started from its seat, and as it passes through the gun, the pressure exerted upon it is substantially maintained by reason of the continuously extending fire area, and this continues until the powder-cake is substantially all consumed; it being the design to construct the cartridge so that the powder will be all consumed before the projectile reaches the end of the bore. In this way a comparatively low maximum pressure may be substantially maintained upon the projectile for the greater part or the whole of the time it is passing through the barrel of the gun, the effect being to relieve the walls of the gun from dangerous strains, and to give the projectile a greater velocity and more effective power than is accomplished by cartridges of common construction."

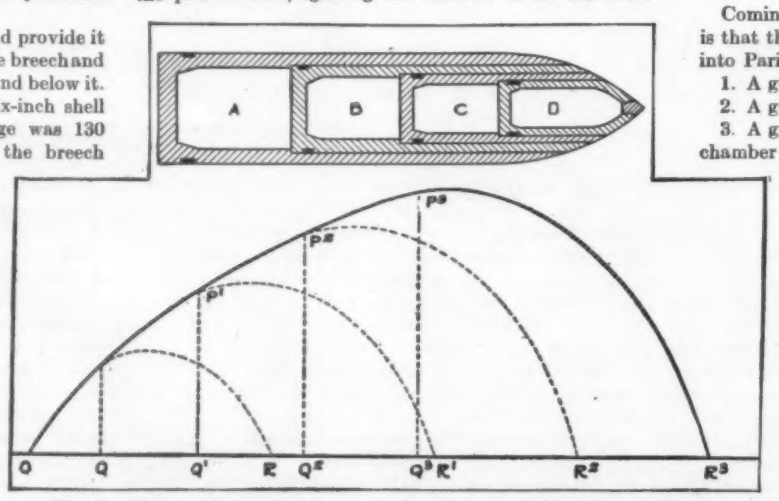


Fig. 3. Theoretical study of suggested compound shell and its trajectory

Assumed charge A gives velocity to B, C, D of 1600 foot-seconds; charge B gives velocity to C, D of 1500 f. s.; charge C gives D velocity of 1400 f. s. Assumed muzzle velocity at O = 3000 f. s. and velocity at P, P1, P2, before explosion of charges A, B, C = 2400 f. s. Assumed new velocity acquired by explosion of charge A at P = ½ velocity acquired by explosion A + 2400 = 3200 f. s.; at P1 ½ velocity acquired by explosion of charge B + 2400 = 3150 f. s.; at P2 ½ velocity acquired by explosion of charge C ± 2400 = 3100 f. s. Trajectory of compound shell = O, P, P1, P2, P3, R3, and its range is O R3. Trajectory of single shell = O, P, R, and its range is O, R.

It should be stated here that the perforated grain was first introduced by that great artillerist, General Rodman, during the period of the Civil War.

Super-Range Awaited Gun Steel and Smokeless Powder

Thus we see that over thirty years ago this American inventor, with his slow-burning powder, large powder chamber, and 50-caliber gun, had combined those principles of ballistics which only awaited improvement in gun steel and the development of smokeless powder to make a 75-mile range possible. These principles are clearly illustrated in the drawing, Fig. 5, comparing the powder pressure curves of an old 12-inch, black-powder, breech-loading gun with a modern 12-inch, smokeless-powder rifle. The black powder, rapidly consumed, gives a chamber pressure of 24 tons to the inch, which falls rapidly to about ½ ton at the muzzle; the smokeless powder, more slowly consumed, rises to 16 tons at the chamber and falls gradually to 6 tons at the muzzle.

The Super-Range Gun

Coming now to the question of what kind of gun it is that the Germans are using to throw shells 75 miles into Paris, three different types have been suggested:

1. A gun using a compound shell;
2. A gun using a sub-caliber shell;
3. A gun of standard type but with a large powder chamber and a very long barrel.

The Compound Shell

The proposal to use a compound shell has been made frequently during the past few years. The study of the problem, shown herewith, was sent to this office by W. Thibaudeau, Member of the Canadian Society of Civil Engineers, of Montreal. The powder charges, velocities, etc., are of course assumed; and the object of the drawing is to show how the problem would have to be worked out. The projectile consists of three rifled shells and a final loaded explosive shell. The compound projectile, fired from O, itself successively discharges a compound projectile at the points P and P1 of the trajectory, the final projectile D being discharged at P2 and continuing the trajectory to R3.

Supposing that such a projectile could be made to function, its inaccuracy would

be so great as to render the gun useless, even for hitting such a big target as Paris, and this for the following reasons:

To ensure that the successive projectiles shall continue in the true light of flight, the axis of the projectile, at the instant of each discharge, must be tangential to the trajectory. This it never is; for a projectile in flight has a precessional or "nosing" movement, roughly similar to that of a spinning top.

An analysis of this movement was contributed to the SCIENTIFIC AMERICAN by Rear-Admiral Twining, Chief of the Naval Bureau of Ordnance, and published in our issues of August 10th and 17th, 1912. It was written to correct the widely-spread popular belief that a shell does not strike the target head on, and the article brings out certain facts which show the impracticability of securing accuracy with a compound, self-firing shell.

Referring to the drawings, Fig. 4, it is pointed out that after the projectile has traveled a short distance in its trajectory the direction of the air resistance changes, bending toward the horizontal, the resultant force striking the projectile on the under side of the nose, as shown by the arrow. This force does not act through the center of gravity of the projectile, but forward of it, creating a small overturning moment. If there were no rotation, this moment would tend to overturn the projectile; but since the projectile is rotating, the overturning moment causes the projectile to begin to precess about a line passing through the center of gravity of the projectile and parallel to the direction of the force. If the projectile has a right-hand rotation, it will start precessing to the right; and the projectile will behave like a top that has not gone to sleep. But while a top makes a number of complete precessions the projectile makes only partial ones; and, because of the high speed of rotation of the projectile, (4,000 to 20,000 revolutions per minute, or even greater) and the relatively small overturning moment of the air resistance, the time for a complete precession would probably be one or more seconds, depending upon the conditions.

Before the projectile has finished more than part of a complete precession the direction of the air resistance has again changed, striking the projectile farther under the point, and another precession starts about the new direction of the air resistance—the point of the projectile again bearing off to the right. The point of the projectile, therefore, describes a series of cusps, the horizontal traces of which, if we could look down upon the path of the projectile from above, would be practically cycloids; and the course would appear as shown in the full line in drawing No. 4. Under the action of these forces, the axis of the projectile may diverge several degrees from the trajectory.

Now, applying this to the compound shell, it is evident that, should the discharge of successive parts of the shell occur when the axis of the projectile was bearing so many degrees to the right of the true trajectory, the new shell would be propelled on a divergent course; and it is conceivable that the three successive discharges might

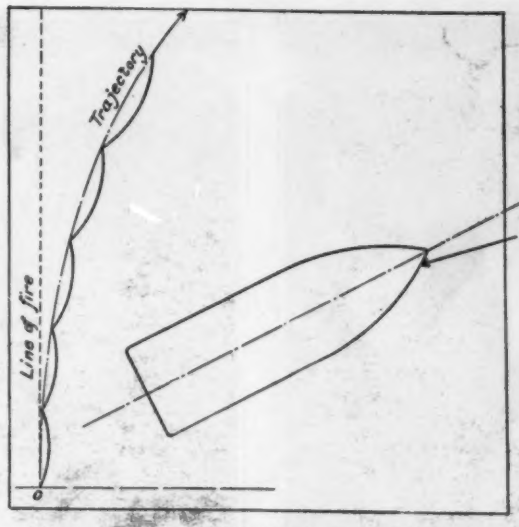


Fig. 4. Unbalanced air pressure in direction of the arrow causes a precession of the shell, and the nose of the shell describes the path shown

produce a maximum divergence so great that, on a range of 75 miles, the shells would land anywhere from, say, five to fifteen miles from the point aimed at.

The compound shell, then, would be so extremely erratic as to preclude its use for military purposes—even supposing that it could be made to function at all.

The proposal to utilize compound shells has been frequently made to this office, but Mr. Thibaudeau is the first correspondent to place the problem before our readers in its broad outlines.

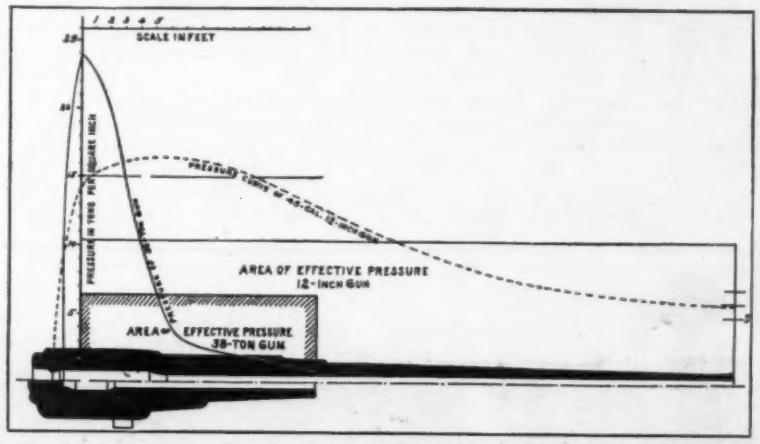


Fig. 5. Comparison of powder pressures in an old quick-burning, black-powder gun and a modern smokeless, slow-burning powder gun

Howitzer with Sub-Caliber Shell

The compound shell being impracticable there remain two practicable ways in which the Germans may have solved the problem of throwing a shell 75 miles:

1. By the use of a sub-caliber shell;
2. By the use of a rifle of standard construction but of great length and very large powder chamber.

The very reasonable suggestion that the Germans are using sub-caliber shells has been made by Hudson Maxim, whose name will always be associated with our developments in smokeless powder and high-explosive fillers for armor-piercing projectiles. The advantages are that a howitzer of standard construction can be used, and the only novelty involved would be in the seating of the shell and the designing of a powder suitable to the high velocity developed.

Referring, now, to drawing No. 6, let us assume that we have a 16-inch howitzer capable of imparting a velocity of 1,500 foot-seconds to a shell wighing 2,000 pounds. Let us load into that howitzer a shell of half the diameter, or eight inches, provided with a cone-shaped driving base. This base carries the copper driving band, and its forward face is provided with massive lugs engaging pockets in the base of the shell, for the purpose of transmitting rotary movement from the base to the shell. A ring supports the forward part of the shell, and guides it in its path down the bore. Both guiding ring and base are split in order to ensure that when the shell leaves the muzzle they will fly apart, disengaging themselves from the shell and leaving it free to make an uninterrupted flight.

Now, let us assume that the weight of the shell, its ring and its driving base is 500 pounds. Since the full-caliber shell weighs 2,000 pounds, it follows that, if the right kind of powder is used, the 500-pound shell will leave the muzzle at a velocity of 6,000 feet per second, which would be more than sufficient for a 75-mile range. This calculation is based on the law that the velocities developed in two projectiles by the same force are inversely as their weights.

The difficult part of the problem would be to provide a powder that would burn four times as fast as the powder used with the 2,000-pound shell, and it is possible that by the time this was done, it would be found that the gun itself would have to be redesigned.

Type of Guns Used by the Germans

It is our belief that the gun used by the Germans is a standard gun, with an unusually large powder chamber and great length of bore. The powder chamber and length would be closely related to the powder pressure, and this would be limited by the strength of the gun and the desire to reduce erosion and give the gun as long a useful life as possible. If the powder pressure were maintained within reasonable limits, the gun might have to be as much as 100 calibers in length. If this were the case it would be necessary to stiffen the gun; for the elasticity of the steel would cause the gun to droop, and its axis, instead of being straight would be a curve, with the result that there would be severe whipping of the gun when it was fired. Hence, the gun would have to be stiffened, either by a plate girder beneath it, as shown, or by carrying it within a deep latticed truss.

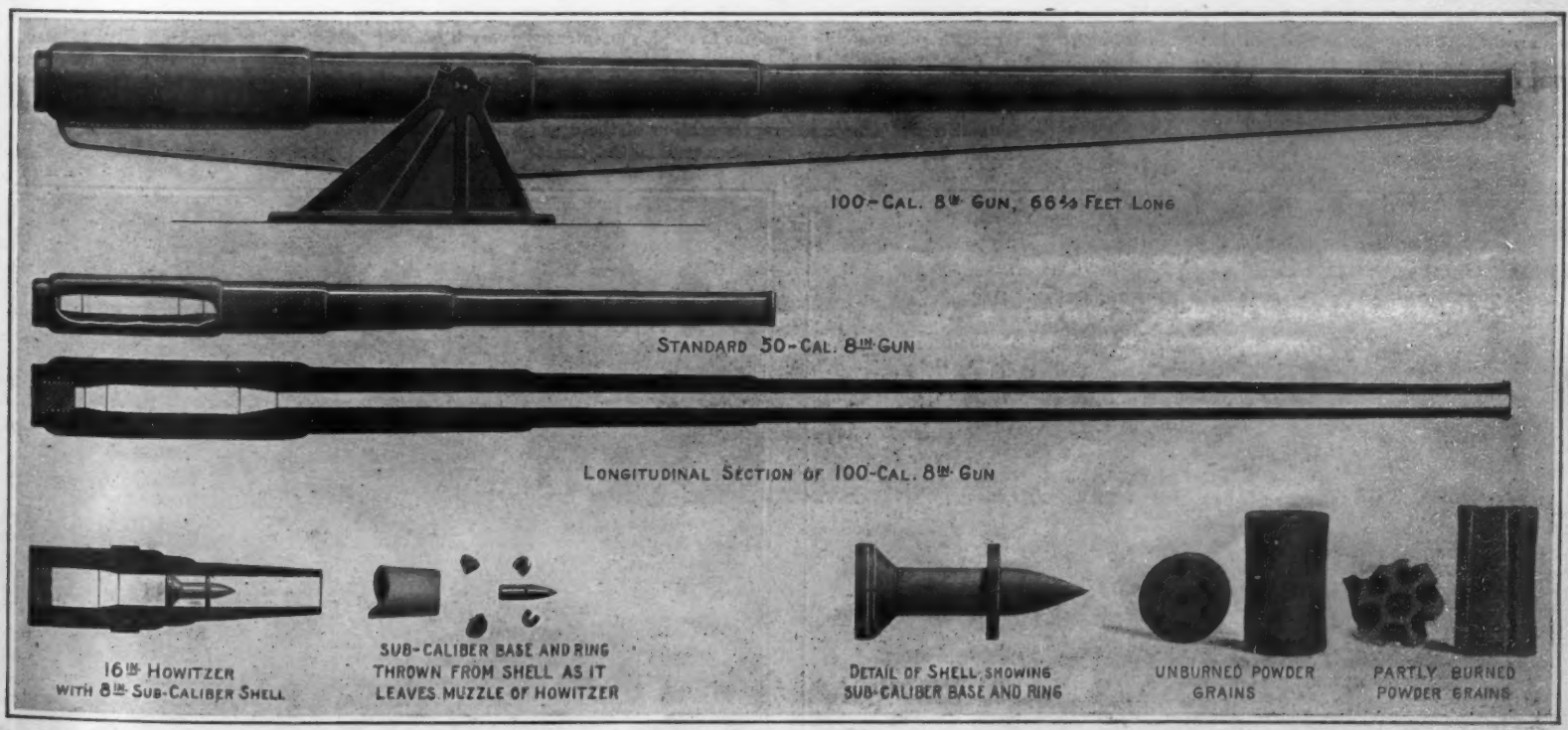
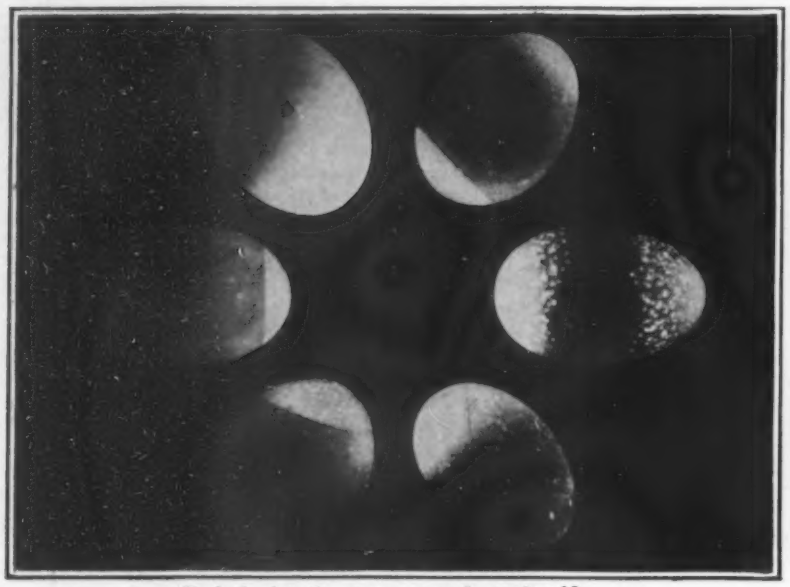
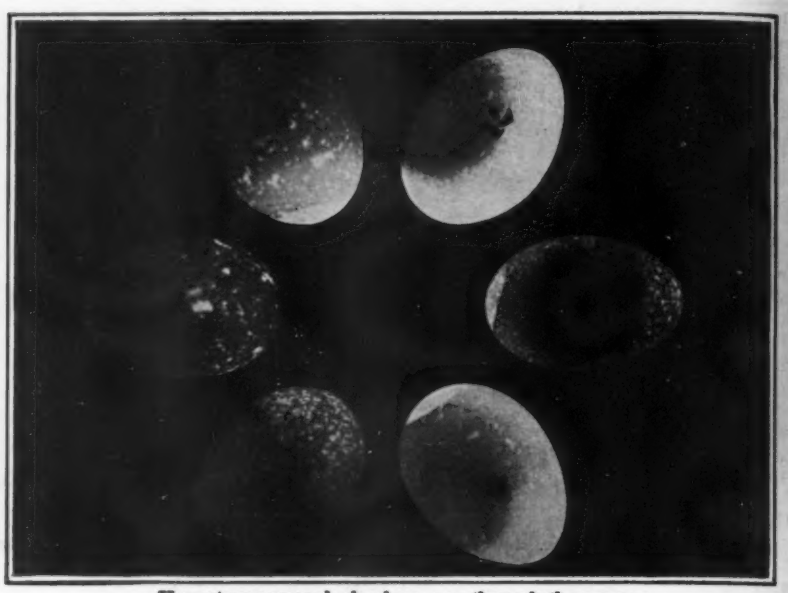

100-CAL. 8IN. GUN, 66⅔ FEET LONG
STANDARD 50-CAL. 8IN. GUN
LONGITUDINAL SECTION OF 100-CAL. 8IN. GUN
16IN. HOWITZER WITH 8IN. SUB-CALIBER SHELL
SUB-CALIBER BASE AND RING THROWN FROM SHELL AS IT LEAVES MUZZLE OF HOWITZER
DETAIL OF SHELL SHOWING SUB-CALIBER BASE AND RING
UNBURNED POWDER GRAINS
PARTLY BURNED POWDER GRAINS

Fig. 6. Upper drawing represents the barrel of a 100-caliber, high-velocity gun (shown without its recoil mechanism) designed for high, but not excessive, powder pressure. The plate girder is necessary to prevent drooping at the muzzle. The lower drawings show a howitzer, a sub-caliber shell and smokeless powder grains



Typical prints from eggs several months old



How storage eggs look when seen through the camera

Testing Eggs by Photography

Some of the Things Which the Eyes of the Camera Sees When it Looks Through the Hen's Creations

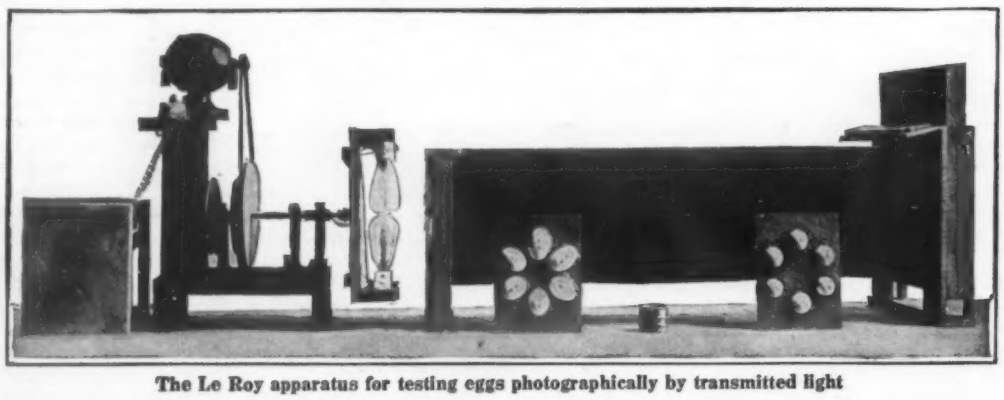
By Jacques Boyer

HERETOFORE, in order to learn the state of preservation of an egg, or to distinguish a storage egg from a fresh one, the process of holding up to the light has been the only one available. In the Paris market eggs are sold, whether privately or at auction, through sworn agents holding government appointments. Then, whoever the shipper or the buyer, they pass through the hands of the official inspectors whose duty it is to verify the number and the quality in each package.

These inspectors work, seated two by two, in a dark place close to a case of eggs, with a lighted candle between them. In each hand the worker takes two eggs, bringing them one after another between his eye and the flame. The egg appears transparent or spotted according as it is good or bad. Once the eggs, which are held between the thumb and first two fingers, are examined, they are exchanged by a bit of skillful juggling for those held in reserve in the palms, and these are inspected in the same way. If they are good they are then placed in another case, count being kept of them; if they are spotted or broken they are promptly consigned to the discard.

Unfortunately, of the various valid causes for rejecting an egg, several defy detection in this fashion. In particular, the repulsive odor which proceeds from packing in wet straw gives no visible evidence of its presence. Accordingly M. Georges Le Roy, director of the municipal laboratory at Rouen, has tried to devise a more scientific method of analysis. He has not yet got his procedure to the place where it can be carried out rapidly enough to replace the older technique as a commercial process; but on a laboratory basis it works so admirably that there is great hope and great desirability of his ultimately being able to do this.

Like the old, the new process depends upon the air-chamber in the egg; but instead of relying upon the visible variations in this chamber, M. Le Roy takes a photographic print of it. At first he had a notion that he might be able to use the X-ray; but the radiographs of eggs which he obtained gave large and distorted images, difficult to measure, as our reproduction shows.



The Le Roy apparatus for testing eggs photographically by transmitted light

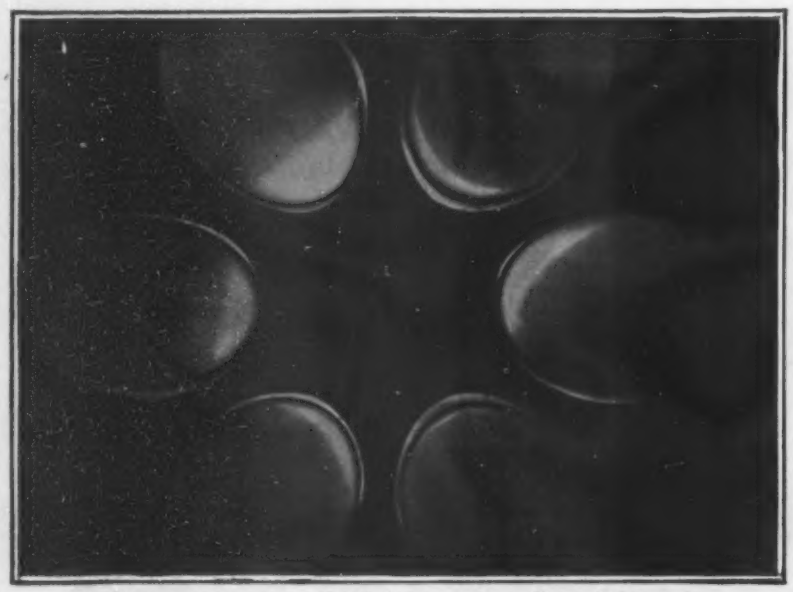
Contrasted with these unsatisfactory results, M. Le Roy was able, by direct photography, taking advantage of the transparency of the eggs, to secure highly characteristic data. It was only necessary to employ an intense light, a powerful lens, a highly sensitive plate, and an exposure of from one to three minutes. The prints thus obtained, whether on large or reduced scale, gave an exact and easily interpreted representation of the eggs.

Of M. Le Roy's apparatus concerned in the direct business of photographing, we need mention only the ingenious metal plate with six oval holes in it, so disposed that the eggs may lie with their major axes all pointed inward to a common center, and at just the right angle to get the most effective image, on the plate, of the whole end containing the air-chamber. The light from powerful lamps is not reflected from the eggs, but passes *through* them to fall upon the sensitive plate.

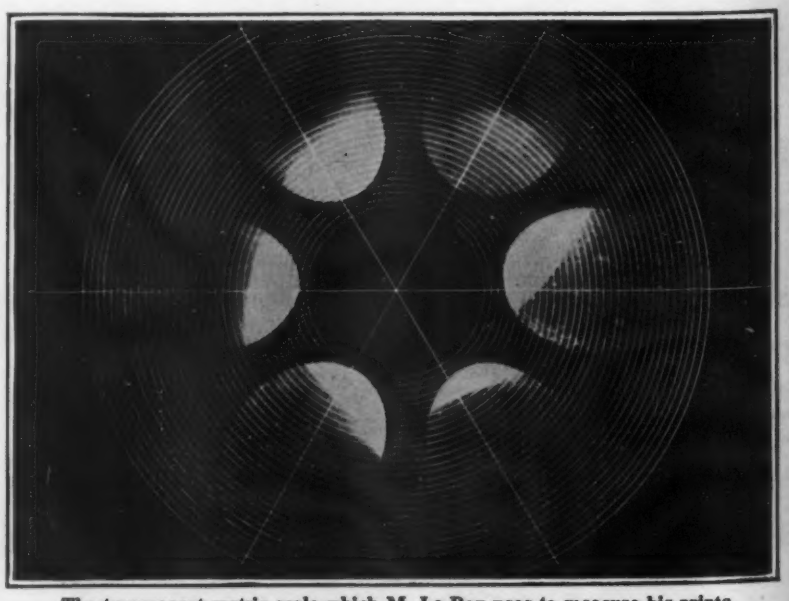
To provide a ready means for measuring the image of the egg and of the air-chamber, and thus determining the relative size of the latter, M. Le Roy got up a rather clever transparent gage. This, consisting of six lines radiating from a common center and crossed by a quantity of concentric circles, may be laid over the print, or, by insertion between the plate and the paper during process of printing, may actually be made a part of the record.

Less Soap, Better Health

SOAP saving is not only economy of fats, according to Dr. Samuel Dixon, health commissioner of Pennsylvania, but may be made a factor in cutting down respiratory diseases. Many persons abuse soap by making a stiff, creamy lather in bathing, under the belief that this is necessary to dissolve dirt that fills the pores of the skin. On the contrary, very little soap is required to break up dirt and permit water to remove foreign substances from the pores so that glands may perform their normal function. Excessive use of soap usually fills the pores with fatty substances and results in imperfect action of the sweat glands, a cause of disease, especially of a respiratory nature.

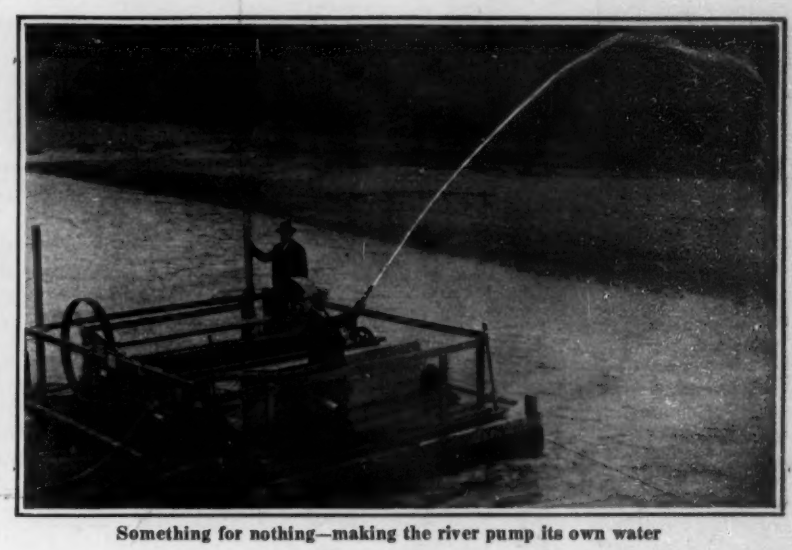


The unsatisfactory result of trying to secure radiographs of eggs



The transparent metric scale which M. Le Roy uses to measure his prints

The current motor with which the flowing river is harnessed to an irrigation pump



Something for nothing—making the river pump its own water

A Motor Operated by a River's Flow

THE problem of perpetual motion still remains unsolved, despite the centuries of time and vast amount of brain power devoted to its solution. But many mechanical tricks can be performed which, on the surface, look like perpetual motion; and frequently useful application is found for one of these. In this class appears to fall the apparatus built by J. H. Martin of Springfield, Mo., by means of which he hopes to derive power from the current of a river, without any artificial head. Mr. Martin has invented many ingenious contrivances during his life; but as a mechnical curiosity none of them is in the class with his latest machine, a model of which he has recently been operating on the bosom of the Arkansas River, near Pueblo, Colo.

Mr. Martin's contrivance looks simple enough. It consists of a wooden framework about 16 feet long by 12 feet wide, which is floated on two buoys and is secured to the bank of the river by cables. Inside the framework are slung two sets of sprocket wheels attached to each other by chains. Attached to the chains, at equal intervals, are four big wooden paddles or vanes, seven feet long and two feet wide, each giving a surface of about fifteen square feet. They are so placed that when two of them are above the water, the other two are underneath, furnishing resistance surfaces for the river's current. The vanes are geared to two 100-gallon force pumps, and with a six-mile current, five feet deep, these pumps will force water through a three-inch pipe to a height of 100 feet and at the same time operate a four kilowatt dynamo to full capacity. The two pumps generate about fifteen horse-power.

It is easy enough to force a broad resisting surface along with a reasonably strong current of water, Mr. Martin explains. The problem comes when the paddle is lifted out of the water, at the same instant that the paddle at the other end of the framework is descending into the water. The resistance represented at one end will invariably neutralize the movement at the other end, thus causing a cessation of movement altogether.

Here is where a knowledge of hydrostatics was necessary, Mr. Martin rigged up some auxiliary paddles on each of the main vanes, slung on hinges. Then by the addition of ratchet arrangements on the big vanes, he forced the latter to assume a perpendicular position while under the water, the vanes being automatically released at the instant the sprocket wheel begins to lift them out. Hence, the resistance surface of the paddles in the water are always greater than that of the paddle about to enter the water, and the problem of water current power was solved.

A four-mile current is enough, according to Mr. Martin, to make a force of 100 gallons a minute, pumped 100 feet above the surface of the river. A contrivance attached to the machine enables the operator to vary the depth at which the current will take effect, thus regulating the speed and consequently the strength of power. The cost of installation, according to the inventor, is about $40 per horse-power; and the cost of operation is practically nothing, being about three cents per day to oil eight journals.

The value of this invention lies in its ability to pump water with sufficient force to insure irrigation power for any farm or ranch in a dry section, and in the fact that it will work continuously so long as there is a river to run it. The total cost of irrigating now runs from $1.40 to $25.00 per acre per year, depending upon locality and conditions. One of these machines will irrigate about forty acres, as in 24 hours it pumps 288,000 gallons of water.

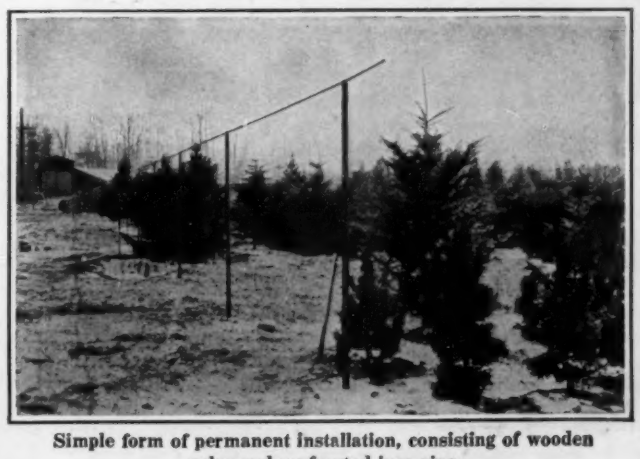
Doing Without Rain on the Modern Farm

YOUR up-to-date farmer cares little whether it rains ot not. By the mere twist of a valve he can turn a gentle shower on his fields for any length of time best suited to the requirements. If it rains naturally, so much the better; but during drought he supplies his own rain so that his crops do not dry or wither or burn or otherwise become a partial or total loss.

Three different schemes for producing artificial rain have been tried by farmers, horticulturists and tree nurserymen at East Rutherford, N. J., just outside the busy city of Passaic. The simplest consists merely of a straight length of pipe with nozzles at regular intervals; it is capped at one end and provided with a flexible rubber hose at the other, connecting with a nearby water main. A short length of pipe joined to the main pipe at either end by means of a T-fitting, serves as a handle for directing the streams from the numerous nozzles. With an arrangement of this kind supported on a number of low stakes, it is possible for the truck farmer to place a gentle rain in any part of his field. The same pipe, obviously, can be used to cover quite an area at one setting by merely turning it axially. When a new area is to be watered, the pipe can be carried to the next location by two men. So the cost of this system is negligible as compared with the more convenient but expensive watering schemes of the permanent type.

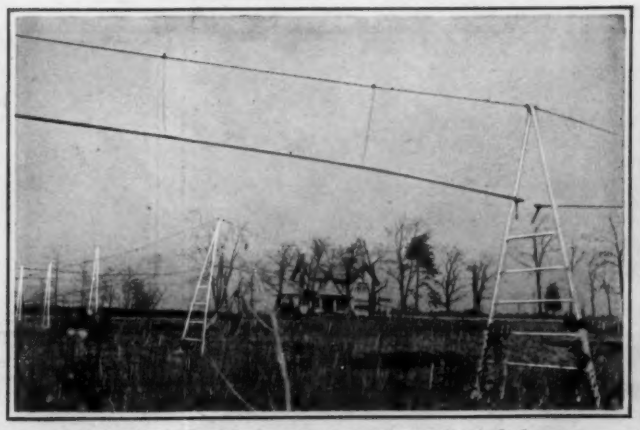
A grower of flowers nearby has installed a most elaborate watering system, consisting of 15 towers of V-shape, made of three-inch pipe. These towers serve to hold a steel cable from which is suspended a perforated one-inch pipe. With such an arrangement artificial rain can be produced by turning on the water. In winter the water is withdrawn, so that there is no danger from bursting pipes.

The third and last system in this locality is used by an evergreen nurseryman. It consists of wooden poles supporting a perforated pipe at a heightof six feet.

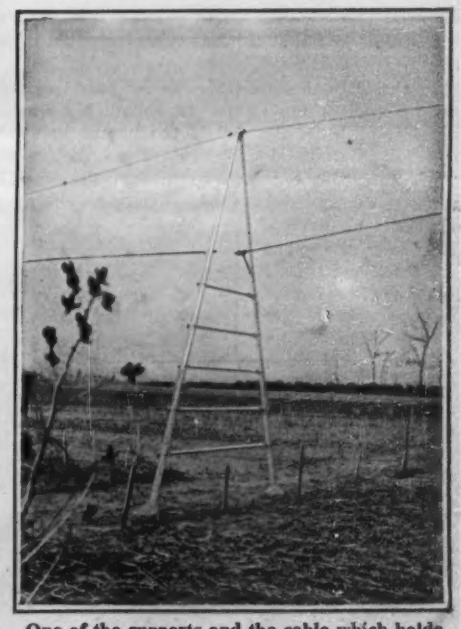


Simple form of permanent installation, consisting of wooden poles and perforated iron pipe

Consisting of a pipe with handles at each end, this appliance can be moved about



Fifteen V-shaped supports carry the perforated pipe which waters this horticultural garden



One of the supports and the cable which holds the water pipe high above flower beds

Work of the U. S. Naval Observatory

The current annual report of the superintendent of the Naval Observatory points out the fact that the astronomical work is now more important than usual at many European observatories under stress of war conditions. During the past year the observations with the 26-inch and 12-inch equatorials have been limited to comets, occulations and asteroids of special interest and observations for instrumental constants. The photographic telescope has been used chiefly in the observation of asteroids. The observatory continues to make regular observations with the photographic zenith tube for the determination of the variation of latitude. A discussion has been made of the proper motion of Alpha Lyræ, based on about 1,800 observations between 1893 and 1912.

The Motor-Driven Commercial Vehicle

Conducted by VICTOR W. PAGÉ, M.S.A.E.

This department is devoted to the interests of present and prospective owners of motor trucks and delivery wagons. The editor will endeavor to answer any question relating to mechanical features, operation and management of commercial motor vehicles

Special Motor Truck for Moving Troops

THE recent army truck test over the Dixie Highway between the cantonments at Atlanta and Chattanooga to determine the speed with which troops can be moved in an emergency by motor truck in comparison with the known rate of travel by cavalry or railroad, proved to be a revelation, not only in showing the higher speed of motor trucks, but also in emphasizing the importance of many factors besides mere speed. If the result of the test may be taken as a criterion, the use of motor trucks for troop transportation will mean greater activity in road construction, almost unlimited "marches," complete absence of fatigue, total independence of rail services for small troop units, an insignificant cost of operation, and an extreme degree of mobility under which four days of forced marching by cavalry may be reduced to one day's operation by motor truck. Although the practicability of motor trucks for military service is now obvious and although the high speed demonstrated in the test exceeded the expectations of the officers who conducted it, they were greatly impressed with the importance of the body design employed in troop transportation and the extent to which road conditions influenced the result.

Special troop-transport body which handles two squads with full equipment

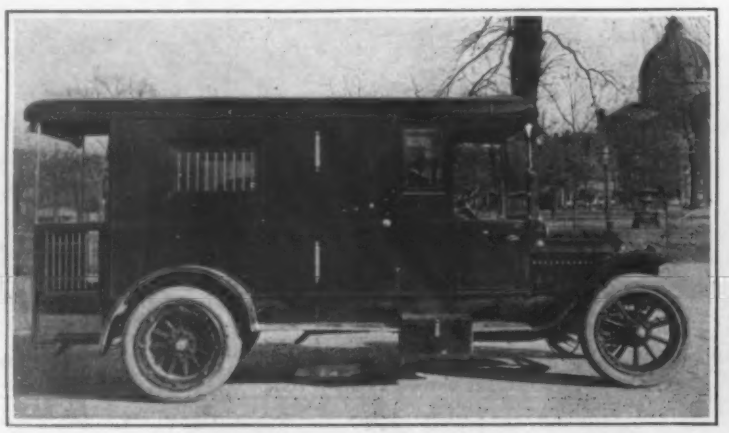
This was apparent from the interest shown by army officers in the standard type truck with the special troop transport body, which was prepared for purposes of the test. Six trucks of other types, carrying regimental supplies, participated in the test and the whole demonstration was closely watched by prominent American army officers detailed to make a report on the Gallagher transport body, and several French army officers. Before the authorities inaugurated this test, it had never been imagined that a detail of men could be carried on a motor truck 132 miles over good and bad foothill roads, with perfect comfort and safety, in five or six hours. Yet the special transport covered the route in five hours and thirty-three minutes on the outbound trip and five hours and two minutes returning. The six supply trucks, however, required eight hours or more. At times the speed of the transport was as high as 49 miles an hour. Such performances, admittedly too fast for a large number of trucks operating on a single road, nevertheless showed the possibilities that lie in the motorization of troop transportation. An officer said the test showed that a whole regiment could be moved over the route in seven hours.

In rushing out details of men for patrol or skirmish duty at points too remote to be quickly reached by cavalry, or when the call is too urgent to await the assembly of railroad cars, the troop transport showed what could be expected in an emergency. The observing officers did not hesitate to express their surprise that the truck had beaten the time of the fastest train between the two points. The official report was favorable to the test and to the special transport body. One of the features of the Gallagher body design enabling fast driving is the perfect balance of the load, The troops sit back to back lengthwise of the body and their rifles, when not immediately needed, may be stored in rifle chests built between the backs of the seats. The foot rails and arms rest protect them from being swayed or thrown off when rounding corners at high speed or moving rapidly over rough roads. The footrail is one of the important features of the design because it is hinged and lowered to serve as a step when mounting and then raised and locked in position to act as a foot brace when riding. The new transport is expected to eliminate baggage wagons to a large extent as each man carries his own shelter tent, blankets, extra underclothing, shoes and all other equipment usually carried by troops on the march. All of this material is carried in lockers under the seats, which are accessible when riding on the truck or when standing on the ground. Special lockers are provided for 500 rounds of ammunition for each man. In the rear of the truck there is a compartment that will hold three days supply of the non-perishable components of rations, such as coffee, sugar, bacon, baked beans, hard bread, etc. It is obvious that this feature makes the truck of such wide utility that its limits can only be guessed at.

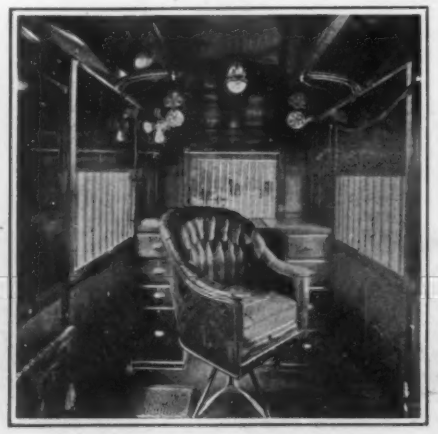
Hauling food for sheep during the severe weather last winter

Where the Wind Blows From the Northwest

A CURIOUS phenomenon of weathering has been noted upon the pyramidal granite monument erected at the summit of Sherman Pass, alongside the track of the Union Pacific railroad, to commemorate the work of the Ames Brothers in building the line across the mountains. The bronze medallion of Oakes Ames, upon the southwest face of the pyramid, is in condition practically as good as when put up; but the relief on the northwestern tablet has been worn down considerably by the prevailing winds, which blow from that quarter.



Bank on wheels, a valuable convenience for paymasters and depositors



Elaborate interior of the banking truck

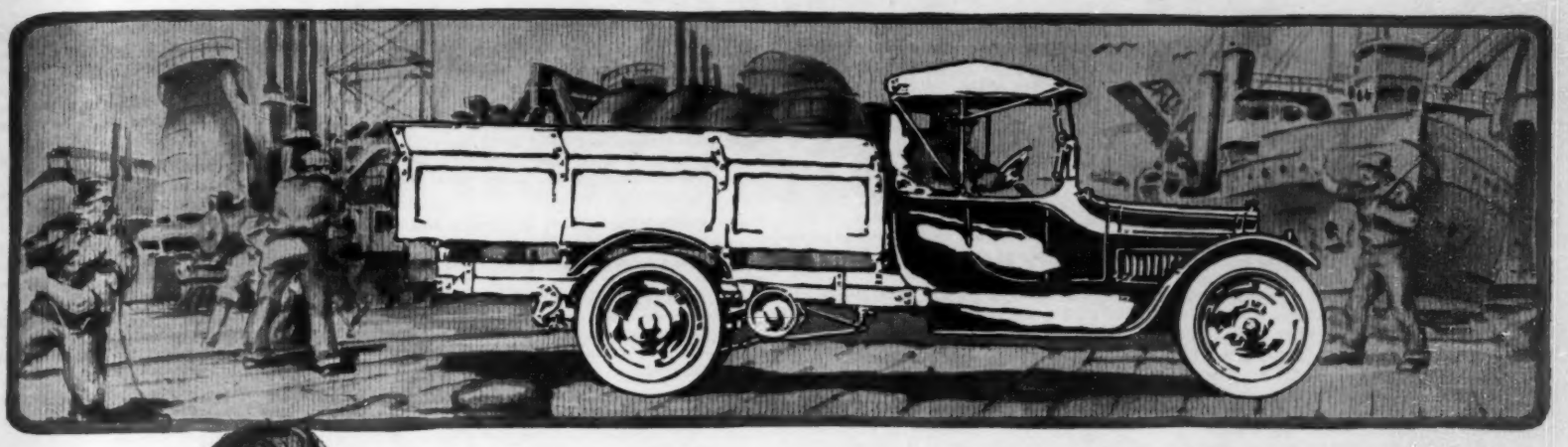
The Motor Truck as a Sheep Saver

DRIVING a motor truck on a sheep range during the winter months is a real man's job and an undertaking few women would care to attempt. But the wife of the superintendent of a Wyoming ranch is not a woman of the ordinary type. To her lot fell the piloting of a truck and the braving of Wyoming blizzards, the greater part of last winter, that feed might be hauled to the 33,000 sheep on the range. It was only her pluck and perserverance and the use of the truck that saved the lives of many hundreds of the sheep, as she transported the much needed oil cake that kept the sheep from starvation when snow for months at a time covered the ground to a depth of several feet. The picture in the center of the page gives some idea of the difficulties under which this work was accomplished.

A Truck That Collects Deposits After Banking Hours

MANY a business man has hurried home late at night with one hand firmly gripped around a large wallet of greenbacks in one pocket and his finger on the trigger of a six-shooter in another, merely because he was unable to deposit the money in a bank during banking hours and there was no convenient place for him to safeguard it until the following day. Through the enterprise of a taxicab company, this same gentleman, if he is a resident of the Quaker City, can now have a burglar-proof portable savings bank call at his office or any other part of the city where he may happen to be, place his funds in a steel safe and forget all about them until the bank opens its doors the next morning.

The portable savings bank is nothing more than an elaborately furnished office mounted on a standard three-quarter-ton truck chassis. It has been used to great advantage by contractors, railways, paymasters, savings banks, theaters, lodges, churches, clubs, societies and others who wished to provide safekeeping for large sums of money collected late at night and outside of regular banking hours. The cost of this service is very economical, being only double that of the regular taxi rates. In most cases the money is passed through a heavily barred receiving window on the rear platform of the truck to an attendant who sits at a mahogany desk just inside. After it has been counted and checked it is transferred to a large steel safe which can be opened only by knowing the combination. The desk where the attendant sits has several large drawers and special compartments for filing records and other business papers. The deeply upholstered chair would arouse the envy of many bank presidents. The truck is brilliantly lighted at night by several large electric lights and has other conveniences such as an electric fan for hot summer days, and a special heater connected with the exhaust of the truck engine, which keeps the attendant and his assistants warm in winter weather. A speaking tube is provided for communicating with the driver. The truck has attracted considerable attention on the streets and is believed to be positive insurance against bandits and highwaymen, not to mention its advertising value.



ASK your Motor Car Dealer at what time he comes nearest to losing you as a satisfied customer and he'll tell you it is when you and he try to fix a "trade-in" price on your old car.

—You know what your car will do, and what it should be worth—but he knows what he can get for it and that is the ANSWER.

—YOU are the one that stands the loss. 40% to 50% is the first year's depreciation on your car. Take anything else you own. 10% to 15% is "charged off" the first year and is the basis for depreciation after that.

—This is most unjust, especially when analysis of conditions shows that 70% of all "traded-in" cars are as good mechanically as the day they were purchased.

—Attach a Smith Form-a-Truck to your car

—make a truck out of it

—put it to work in your business

—make it earn $5 to $7 per day

—it will easily do the work of three teams.

—Write us about your car, we will give YOU some interesting facts and figures.

Standard Attachment
for Ford cars,
One ton . **$390**

Universal Attachment
for all other cars,
One ton . **$450**
Two ton . **550**
F. O. B. Chicago

SMITH MOTOR TRUCK CORPORATION
CHICAGO

Smith Form-a-Truck

RECENTLY PATENTED INVENTIONS

These columns are open to all patentees. The notices are inserted by special arrangement with the inventors. Terms on application to the Advertising Department of the SCIENTIFIC AMERICAN.

Pertaining to Apparel

GLOVE.—H. A. TAYLOR, 88 Central Park West, New York, N. Y. Among the principal objects which this invention has in view are, to avoid damaging the border or finished facing about the wrist openings of gloves, to secure the facing about the wrist opening with an extensible means for fastening the edge of the facing to the glove, and to impart a neat appearance to a glove having a binding facing for the wrist opening.

NECKTIE HOLDER.—R. HAMMERLY, 125 Rector St., Union Course, L. I., N. Y. The object of the invention is to provide a necktie holder formed with wings which may be disposed under a collar and a depending shank with a guideway in which an extension is disposed, and to which an eye is connected by a spring. In use a necktie may be disposed around the shank and wings which may be placed under the collar ends and the eye connected to the collar button.

FRONTLACE CORSET.—S. J. NEWMAN, P. O. Box 437, New Haven, Conn. This invention has for its object to produce a construction whereby the usual lacing is arranged in front instead of in the back, a proper fit being secured. Another object is to provide a corset having a solid back and open front together with an elastic vest structure which will temporarily hold the body in position preparatory to the lacing, which lacing may be placed under any tension, the same being arranged centrally of the body.

Of Interest to Farmers

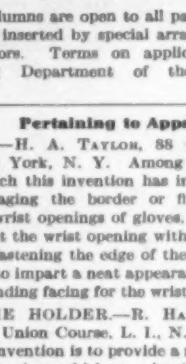
HOE.—R. N. MOORE, Box 23, Mitchell, Iowa. An object of the invention is to provide hoe elements adapted to be readily applied to the ordinary frame, and having a form and an adaptability of adjustment whereby to effectively perform the work of hoeing at opposite sides of a row of plants. A further object is to combine with front and rear hoe elements and their attaching means a shield to prevent injury to the plants.

STRAW DISTRIBUTING ATTACHMENT FOR HARVESTERS.—G. C. MICHAELS, R. F. D. No. 2, Davenport, Wash. The general object of this invention is to provide a distributor of comparatively simple construction, reliable and automatic in operation, so as to evenly distribute the straw over a wide area of ground that it may be readily plowed under the distributer being in the form of an attachment which is applied to the rear of a harvester so as to be operated therefrom.

ROAD GRADER.—N. STOBY, JR., Bozeman, Mont. The invention has for its object the provision of mechanism in connection with graders for handling the blade with power derived from the wheels of the grader, wherein the power may be applied to lift the blade to vary the cutting angle, or to swing the blade with respect to the grader.

Of General Interest

LOOSE-LEAF PASS BOOK.—T. P. MARTIN, Jr., care of Oklahoma Stock Yard, National Bank, Oklahoma, Okla. The invention is particularly adapted for use of bank depositors. Under this system the leaves are removable and may be placed on an adding machine and balanced, and then replaced, so as to start a new page of entries,



A PERSPECTIVE VIEW OF THE ENTIRE LOOSE LEAF FOLDED FOR ATTACHMENT TO THE COVER

or if the bank bookkeeper does not wish to wait for the customer's pass book to come in at the end of the month, he may take a new sheet from the stationery cabinet put down the deposits from the original slips on file, also put down the checks, and balance the account and enter the balance at the top of the new page of the loose leaf.

BUTTON SNAP FASTENER.—G. FLESSA, Hotel Shattnir, Berkeley, Cal. The patent relates more particularly to snap fasteners of the button shape, the object is to provide a fastener which may be utilized without detriment as to either appearance or usefulness when either exposed or concealed, one capable of use in connection with light, medium and heavy goods, and of simple or elaborate design.

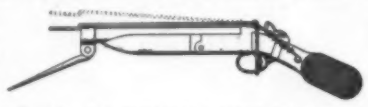
SYSTEM OF EXTINGUISHING FIRE.—D. DECKER, Rockville Center, L. I., N. Y. The invention relates to a system of extinguishing fires by the utilization of what may be termed smothering gases, its object is to utilize gases from smoke stacks either alone or mixed with carbonic acid gas. Another object is to clean the smoke of certain particles and then discharge the same into a space in which a fire is located for preventing combustion by the expulsion of air.

FOLDING CROSS.—H. T. WALNOW, 446 W. 35th St., New York, N. Y. The object of the invention is to provide a folding cross which may be used either as a novelty or as an ornament to be worn on the person, to provide a structure whereby the parts may be folded for changing the general appearance of the device or for the purpose of packing when shipped.

CIGARETTE OR CIGAR HOLDER.—N. M. BOYAJIAN, 329 Columbus Ave., New York, N. Y. The invention has for its general object the provision of a holder of comparatively simple and inexpensive construction, so designed that the nicotin or tobacco is effectively prevented from reaching the smoker's lips or tongue, and at the same time discoloring of the smoker s fingers from nicotin is prevented.

APPARATUS FOR PURIFYING AND HUMIDIFYING AIR.—A. W. LISSAUER, care of Edwin Horwitz, 115 Broadway, New York, N. Y. The object of this invention is to provide an apparatus for controlling the temperature of the moisture supplied to the air so as to deliver said air at a constant saturation temperature or absolute humidity.

GUN.—F. L. FENCL and F. M. HINKLE, Table Rock, Neb. The object of this invention is to provide a gun especially suited for destroying gophers, the gun provided has a short barrel and a pistol grip, the muzzle of the barrel is provided with a stake for enabling the gun to be arranged



A SIDE VIEW OF THE INVENTION

in a vertical position above the gopher-hole, the trigger operating mechanism is provided with and operated by a link extending beyond the muzzle of the barrel for setting off the trigger when the link is moved by the soil which the gopher pushes out ahead of him when leaving the hole.

FISH SCREEN.—J. O. KAFADER, Fort Bidwell, Cal. The invention relates to fish screens, and more particularly to screens required under the law to be employed in connection with irrigating ditches leading from streams, whereby to protect the fish by preventing them from entering the ditch. The device is simple and inexpensive requires little attention. It is in box form, the screen being mounted at its center. In order to deflect logs or like floating matter away from the entrance, it is provided with curved guard fingers extending on either side at the front.

TORPEDO GUARD FOR SHIPS.—E. MATTSON, 30 Second Place, Brooklyn, N. Y. Among the objects of the invention is to provide a guard for each side of a ship adapted to be carried in spaced relation to the hull whereby a ship will be protected from danger from torpedoes, mines or other damaging influences, either while in harbor, at anchor, or under way at sea. A further object is to provide the hull with equalizing devices extending over the ship and serving to tend to equalize the suspension action on the two opposite guards irrespective of the rolling or listing of the ship.

CONTROLLING DEVICE.—M. F. SCHMITT, 825 First Ave., New York, N. Y. This invention relates to despensing beverages, its object is to provide a controlling device especially designed for controlling the number of barrels of beer, ale or other beverages tapped. To produce the desired result use is made of two counting devices, each registering the barrel tapped, one is located adjacent to and actuated by the draw off faucet the other adjacent to and actuated by the outlet valve of the pressure supply apparatus usually located in the cellar. The device provides for a registering of each barrel tapped, and is a safe guard against the proprietor of an establishment being wrongly charged for more barrels than are actually used.

Hardware and Tools

SAFETY LATCH FOR ELEVATOR DOORS.—T. A. MELVILLE, 23d Engineers, Camp Meade, Md. The invention has for its object the provision of a safety latch for elevator doors which cannot be operated except when the elevator control lever is in inoperative position, the operation of the safety latch serving to lock the elevator control lever in inoperative position.

NUTCRACKER.—J. H. SPENCER, care of Spencer Importing and Trading Co., 163 Greenwich St., New York, N. Y. The object of this invention is to provide a nutcracker arranged to accommodate dies which permit of sufficiently cracking the shells of walnut, Brazilian nuts, pecan nuts, and other nuts for convenient removal by hand of the broken shell without danger of crushing or unduly bruising the kernels or meat of the nuts. To accomplish this use is made of pairs of dies for each particular kind of nut to be cracked.

WELL ROD COUPLING.—A. E. GILBERT, 618 N. Bostne Ave., Tulsa, Okla. The object of the invention is to provide a simple and durable construction wherein the coupled members are integral with the rod ends to be joined, and while effectively engaging one another laterally, are prevented from uncoupling except when in inclined relation to one another, and of such a nature as to require but minimum inclination in order that uncoupling may be effected while the elevators are fast to the rod.

Household Utilities

FOLDING BED.—M. COX, 651 Third Ave., New York, N. Y. The object of this invention is to provide a metal folding bed arranged to provide a foldable rack adapted to hold pillows and other bed clothes, or articles convenient to the user. Another object is to provide a table normally held in inactive position on the bed spring frame when the bed is in use, and adapted to be extended when the bed spring frame is in upright folded position.

Machines and Mechanical Devices

MANHOLE BRIDGE.—J. J. IRVINE, 140 Fullerton St., Pittsburgh, Pa. The invention relates to newly packed man or hand holes in boilers and the like, the main object is to provide means for automatically maintaining a steam-tight joint at man and hand holes during the shrinking of the gaskets while the boiler is being started and until the gaskets have reached their limit of compression.

AIR COMPRESSOR.—A. R. BEECK and F. TJADEN, 1330 W. 3d St., Hastings, Neb. This invention has reference more particularly to the operation of the air valve of the compressor. The object is to provide a simple, strong, and inexpensive compressor characterized by an air valve operated mechanically by the initial displacement of the piston rod relative to the piston or its equivalent.

RECORDING DEVICE.—R. C. BRADLEY, care of C. F. Ireland, Mason Bldg., Houston, Texas. The object of this invention is to provide a recording device in which apparatus for printing various data is housed in a small compass, which has apparatus that is readily shifted to record different data under different conditions. A further object is to provide a recording device which is combined with a printing mechanism in such a manner that a permanent record of a transaction may be made accurately and quickly.

MOTOR FOR FLUID METERS.—R. C. BRADLEY, care of C. F. Ireland, Mason Bldg., Houston, Texas. An object of the invention is to provide a meter which is of great accuracy owing to the arrangement of parts and the manner of construction, to provide a meter in which a reciprocating vane has its edges in close contact at all times with the walls of the meter, and in which the pressure of the fluid upon the vane operates the meter, at the same time providing a construction which eliminates friction of the movable parts to a large extent.

COTTON LAP-DYEING MACHINE.—W. F. COX, Box 525, Danville, Va. The object of the invention is to provide an apparatus for treating fabric such as cotton lap, wool or other material in the form of felt, sheet or layer. The apparatus comprises a tank for containing a bath, a truck adapted to pass into, through and out from such tank, beams mounted upon the truck and movable with it, one of such beams adapted to have the goods to be treated wound upon it, and means for unwinding the goods upon the other beam.

HYDRAULIC PRESS ACCELERATOR.—G. A. ENSIGN and J. M. C. DES ISLETS, care of Defiance Machine Works, Defiance, Ohio. An object of this invention is to provide a hydraulic press accelerator arranged to increase the output of the hydraulic press by providing a rapid advance of the hydraulic press piston toward the work until the compression stage is reached, by subsequently advancing the said piston under the direct full pressure of the pump until the desired compression is reached, and by finally returning the piston speedily to normal inactive or starting point.

EXTENSIBLE FORM OR DISTRIBUTING ROLLER FOR PRESSES.—J. F. O'KEEFE, 126 E Ave., Long Island City, N. Y. A specific object of the invention is to provide a roller in which the shaft or spindle is composed of adjustable sections telescopically connected so that the length of the shaft can be varied, and removably applied to the shaft is the sleeve which carries the facing composition of the roller, which may vary in length according to the width of the press or the work to be done.

MECHANISM FOR THE CONTROL OF THE PROPELLERS OF AUTOMOBILE TORPEDOES.—A. E. JONES, Fiume, Hungary. The invention has for its object to provide control mechanism for the propellers of automobile torpedoes by means of turbines. The invention is particularly characterized by its small volume which is a necessary condition for its application to torpedoes in which the available space is very limited.

Medical Devices

DENTAL SLAB HOLDER.—P. SALLES, Box 368, La Fayette, La. The object of this invention is to provide an attachment for the table or tool bracket so that the mixing of the cement can be performed with one hand while the other hand is used to keep the tooth cavity dry. The invention consists of a slab attachment which can be easily, quickly and securely applied, and which will hold the slab in convenient proximity to the patient, so that the dentist can have free access to both slab and patient.

CLAMP.—E. W. CUMMINGS, care of W. W. Wheatley, Attorney, Harrisburg, Ill. The invention has for its object to provide a device especially adapted for use in the operation of circumcising wherein the arrangement is such that the prepuce is firmly clamped in such a manner that there will be no appreciable loss of blood in severing the skin and where the parts are held in such position that they may be easily sutured.

Musical Devices

TROMBONE SUPPORT.—G. MARTENS, 543 W. 160th St., New York, N. Y. The invention relates to musical brass instruments, its object is to provide a support for convenient attachment to a sliding trombone, arranged to support most of the weight of the instrument in the palm of the left hand of the player, and to distribute the grip equally to the several fingers to enable the player to firmly support and grip the trombone without producing undue fatigue.

AUTOMATIC STOP FOR PHONOGRAPHS.—A. C. HENDRICKS, 126 N. Raughley St., Martinsburg, W. Va. An object of the invention is to provide an automatic stop which is simple in its structure, but which may be accurately set to stop the machine at the end of a record whether the record is a short or long one, to provide a stop which is actuated by the movement of the tone arm and which does not depend upon the closure of an electric circuit.

Prime Movers and Their Accessories

INTERNAL COMBUSTION ENGINE.—J. F. and R. F. SCOTT, 407 W. 23d St., New York, N. Y. An object of this invention is to provide an engine formed with a reciprocating member and means for rotating the same during its reciprocatory movement in order that the impulse caused by the explosion of an explosive matter will be translated into rotary motion in such manner as to utilize substantially all the energy in producing the rotary motion and also take advantage of the influence of centrifugal force.

ROTARY INTERNAL COMBUSTION ENGINE.—N. B. DOANE, De Ridder, La. The object of the invention is to provide a simple effective construction, doing away with the use of all valves, as in combustion engines of the reciprocating type, and a construction whereby continuous power movements may be had, applied to the power shaft in its rotary plane of movement, in the first instance, whereby to bring about uniform flexible power application.

Railways and Their Accessories

RAIL-LOCKING DEVICE.—C. ROCHELLE, 717 W. Morgan St., Raleigh, N. C. The invention relates to a device for locking the movable rails of a switch so as to prevent the derailment of a train when the latter is passing a siding due to the crowding of the movable switch points out of their normal position. A further object is to provide spring means for positively holding the movable switch point close to the rail during the normal position of the switch, but which may be moved so as to permit the movement of the rails to permit a train to pass onto the siding.

HOSE COUPLING.—M. A. GREENE, Rupert, Idaho. This invention relates particularly to the hose couplings for use in air steam systems of railway trains between cars, the main object is to provide means for automatically coupling the sections together when two cars are coupled and for automatically uncoupling the same when the cars are uncoupled.

Pertaining to Recreation

CUT-OUT ROCKING TOY.—H. A. HART, 483 Sanford Ave., Flushing, L. I., N. Y. The general objects of the invention are to provide a novel toy which is comparatively inexpensive to manufacture and which a child can readily construct, the toy embodying a body and base which are separately cut out from a piece of cardboard or equivalent material on which the design is printed or otherwise delineated.

Pertaining to Vehicles

SPRING WHEEL.—E. G. HILL, N. 2417 Atlantic St., Spokane, Wash. The object of the invention is to provide a wheel which will give the resiliency of a pneumatic tire without the danger of blow-outs and punctures. In use when the hub moves eccentrically of the wheel the arms of the spokes at one side of the hub will

A SIDE VIEW OF THE WHEEL

move outwardly, lengthening the short axis of the ellipse, while those at the other side will move toward each other, shortening the short axis, and the spokes both above and below, and at the sides, will assist in the cushioning movement of the hub with respect to the rim.

AUTOMATIC HEADLIGHT DIMMER FOR AUTOMOBILES.—V. OLSON, Battery D, 302d F. A., Camp Devens, Ayer, Mass. This invention has for its general object to provide a headlight system which is comparatively simple and inexpensive to construct and is so designed that the headlights of a car will be automatically dimmed and kept in this condition until the cars pass, when the headlights will automatically brighten again.

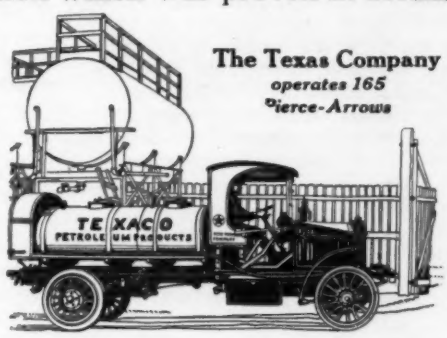
SELF-LOADING AND DUMPING AUTO-TRUCK.—J. A. WARD, address Mrs. John A. Ward, care of Princeton Hotel, New York, N. Y. This invention relates to machines for removing the loose material incident in making excavations, digging canals and ditches, grading roads, building subways, or in removing snow or street sweepings from streets. The object is to provide a self-loading and dumping auto-truck completely under the control of a single operator and arranged to permit of running the truck about from the place of loading to the place of dumping the load, and to manipulate the operating machanism which scoops the loose materials carries it over head gradually filling the wagon body.

NOTE.—Copies of any of these patents will be furnished by the SCIENTIFIC AMERICAN for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

Buy trucks that will last: one now—later a fleet

THE Pierce-Arrow Motor Car Company takes especial pride in the matter of large fleets of trucks operated by big businesses throughout the country.

This pride does not rise solely from the excellence of the Pierce-Arrow truck which these fleets attest, nor the demonstrated ability to render effective, economical service which they evidence, but rather from the fact that each fleet grew out of a single truck installation which was proven in actual service.



The Texas Company
operates 165 Pierce-Arrows

The largest fleet has been six years in building. It grew out of a truck bought in 1912. It now numbers 165 trucks.

This initial purchase, with four others bought soon after, was placed in competition with various other makes to determine the best truck on the market irrespective of price. These trucks were subjected to exhaustive tests which took account of performance, cost of maintenance, of operation and the basic fundamental principles underlying their construction.

During this trial period, the owners visited all the prominent truck factories here and abroad, studied their equipment and facilities, methods and materials, personnel and policies. The future development of the trucks was considered as important as their present performance.

The future could only be foretold from the men, materials and methods employed in the making. These safeguard the permanence of the investment. The Pierce-Arrow truck was selected only after this complete trial and searching inquiry and the subsequent purchases of 160 additional trucks testifies to the satisfactory service rendered. This fleet of trucks is operated in twenty different territories, under widely varied conditions and is serving satisfactorily in every situation. Such a fleet can be operated successfully only when it can command such service facilities as the Pierce-Arrow affords.

Barrett Manufacturing Company
operates 23 Pierce-Arrows

This is a conspicuous example because of its magnitude. Other fleets of lesser number have grown in the same way. They range in number from three trucks up, while many single installations will multiply similarly as they prove their unequalled worth.

The experience of these fleet owners have been uniformly satisfactory in every line of business in which they are represented.

We have data covering these performances which we would be glad to show to those who desire it.

New York Telephone Company
operates 45 Pierce-Arrow Trucks

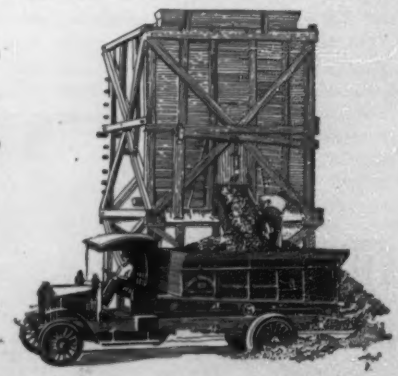
PIERCE-ARROW

Motor Trucks

Here is a typical list of firms, nationally known, which operate fleets of Pierce-Arrows

The Great Atlantic & Pacific Tea Company
operates 95 Pierce-Arrow Trucks

Sinclair Refining Co., Buffalo
The Texas Company
Standard Oil Company
Arbuckle Bros. Company, Pittsburgh
American Express Company, New York
Great Atlantic & Pacific Tea Co., Jersey City
Victor Talking Machine Co., Philadelphia
General Chemical Co., New York
National Grocery Co., Jersey City
Cudahy Packing Co., Chicago
Canfield Oil Co., Cleveland
Armour & Co., Chicago
Winchester Repeating Arms Co., New Haven
New York Telephone Co., New York
L. G. Everist, Sioux City
Spaulding & Spaulding, Buffalo
Ames Transfer Co., Kingsbridge, N.Y.
Central Delivery Co., Inc., New York
Degnon Contracting Co., New York
Lanigan Bros., New York
Manhattan Sand Co., Inc., New York
Thompson Bros., New York-Newark
Acme Tea Company, Philadelphia
James Butler, Inc., New York
Compania Nacional de camiones, Havana
Thomas Roulston, Brooklyn
Lord & Taylor, New York
J. M. Horton Ice Cream Co., New York
United Piece Dye Works, New York
Milwaukee Western Fuel Co., Milwaukee
United Fuel & Supply Co., Detroit
DeFrain Sand Co., Philadelphia
Holbrook-Cabot-Rollins Corporation, New York
Lenox Sand & Gravel Co., New York
Thayer-Griffith Co., Boston
Watson Contracting Co., New York
Fisher Bros. Company, Cleveland
T. C. Jenkins Co., Pittsburgh
E. W. Bliss Company, Brooklyn
Columbia Motor Service Co., St. Louis
Motor Haulage Company, New York
Iron Ledge Quarry Co., Bridgeport
Linde Air Products Co., Buffalo
Pittsburgh Provision & Packing Co., Pittsburgh



Ames Transfer Co.
operates 35 Pierce-Arrow Trucks

THE PIERCE-ARROW MOTOR CAR COMPANY, BUFFALO, N. Y.

Boiler Rooms—Yet Light and Airy!

The Lake St. Power House, Cleveland, has the coolest and best lighted large boiler room in the country.

Yet it has fifty-four 700 horsepower boilers, and nearly all the air for ventilation must come from the side opposite the turbine room.

The boiler batteries run crosswise—six rows of 9 boilers each. There are two roof levels, one just over the boilers, and one over the bunkers and coal conveyors. Between boilers and bunkers are wide ventilating openings, protected by double lines of weatherproof, top-hung Pond Continuous Sash.

Every boiler front is well lighted. Heated air goes straight up and out. From the outer end of each firing aisle a strong breeze sweeps the full length of the aisle.

Similarly in the Ford Power House, with its upstairs boiler room, a division of roof levels enables lighting and ventilating lines of Pond Continuous Sash to be used between boilers and bunkers.

A booklet, "Air and Light in Power Houses," describes fully these and other striking power house installations, and tells more about appropriate forms of sash for such buildings.

DAVID LUPTON'S SONS COMPANY
Clearfield & Weikel Sts. PHILADELPHIA, PA.

We coöperate with your architect or engineer

Lupton
INVESTMENT VALUE

Lupton Steel Sash, Pivoted Factory Type, Counterbalanced Type. Pond Continuous Sash, Pond Operating Device, Lupton Steel Partition and Doors, Lupton Rolled Steel Skylight.

UPPER VIEW
Cleveland Electric Illuminating Co., Lake St. Power House; R. L. Cobb, Chief Engineer. Roof is Pond Truss, Power House Type. Pond Continuous Sash in roof: Lupton Pivoted Sash in boiler room: Lupton Power House Sash in turbine room.

LOWER VIEW
Ford Motor Co., Detroit, Mich.; W. B. Mayo, Mechanical and Construction Engineer. Pond Continuous Sash in roof: Special Pond Continuous Sash in boiler room: Lupton Special Steel Sash in engine room.

ICE MACHINES Corliss Engines, Brewers and Bottlers' Machinery.
The VILTER MFG. CO.
899 Clinton Street *Milwaukee, Wis.*

THE BRIDGEPORT CHAIN CO.
Specialists in Small Wire Shapes & Flat Stampings
Bridgeport, Conn.

When Pack Hardening—

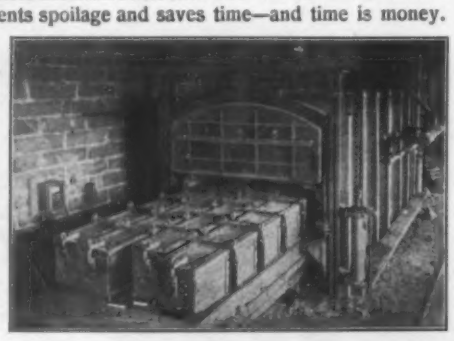
uniformity of temperature in every part of the furnace means that all the work, no matter where placed, will receive equal heating. This is always the case with *Tate-Jones Overfired Accurate Temperature Furnaces.*

This is economy. As the illustration shows, the furnace can be loaded to full capacity every time with complete assurance that each box will contain a uniform finished product. This prevents spoilage and saves time—and time is money. Every Tate-Jones product represents the highest grade material, workmanship and design. It is these that make their reputation and sales.

Write for Circular 154, which gives in detail full information. Specific questions and requests promptly attended to.

Write for booklet—"Heat Treatment of Steel."

TATE-JONES & CO., Inc.
Established 1888
Furnace Engineers
Pittsburgh, Pa.



A Tate-Jones Furnace being loaded with pack hardening work.

Modern Suction Dredging

(*Concluded from page 356*)

the bow by means of a packed hinge, and the discharge pipe leaves the stern through a long rubber sleeve or a reverse-swivel elbow. The pipe line is carried to shore on wooden pontoons or circular steel ones, the pipes, about forty feet long and of ¼-inch thickness, being connected to each other with rubber sleeves two feet long clamped on. When the shore is reached a much lighter slip-joint pipe must be used, usually about No. 10 or No. 12 gage sheet steel, the joints being pulled together by block and tackle on account of the relatively high pressures used. The necessity for keeping this pipe of a size and weight so it can be handled and changed easily by gangs of workmen is what to a large extent limits the size of the commercial dredge to a 22- or 24-inch pipe line as a maximum.

What can such a dredge accomplish, is then the question of greatest importance in the final analysis. When filling the Seattle tide flats, the writer was very proud of being able to pump fine sand through over 5,300 feet of pipe; and at that time the record for pumping soft mud with about the same size machine, of 500 horsepower and with 20-inch pipe, was 6,700 feet, and at 25,000 cubic yards per day.

The modern dredge will easily dig soft rock and pump it a distance of two or three thousand feet; and the writer has recently pumped gravel with quite large boulders to a distance of about one mile, and used about 1,500 horse-power in so doing. This same dredge with 22-inch discharge pipe in both cases, handled as high as 37,000 cubic yards of very soft mud in 24 hours. The great desideratum is to get running time, and the reason for the failure of many dredges is that the machinery is not properly designed and placed, so that constant break downs are the rule.

The material in these fills is retained very often behind temporary bulkheads such as are described in the writer's "Sub-Aqueous Foundations"; often behind brush bulkheads of special design; and also behind concrete sea-walls as at Galveston, Texas, where the material was mostly sand and was deposited two miles away from the dredge by employing a booster in the pipe line. The booster consists of a centrifugal pump, introduced into the pipe line, which picks up the sand laden stream and imparts new velocity, by means of an electric motor as the motive power. The use of several boosters enables the transportation of material some distance.

Without a booster, soft mud can be sent for a distance of 7,000 to 8,000 feet and the writer recently pumped soft sand for a distance of 4,500 feet and lifted it to a height of 45 feet above the water level.

Besides the type of hydraulic dredge illustrated, there is the sea going suction dredge which pumps a load of sand into the hoppers of the vessels as it steams along and when the hoppers are full steams out to sea or deep water and dumps the load, as was done thousands of times by the dredges of this type used at New York in excavating the 40-foot Ambrose Channel.

The third type of suction dredge is one operating just as described for the ordinary pipe-line machine, but built along the lines of an ocean going tug, with a propeller, which can be operated by the dredging engines, when uncoupled from the pump, thus making it possible for the dredge to go under its own power from one piece of work to another location where dredging is to be done.

The illustration shows work in progress at Frontera, Mexico, and the same American company has now under operation four large dredges at Tampico, dredging out the harbor in the Panuco River to enable fully laden oil tank ships to carry oil to the Allied fleets.

The Canadian Government has a river dredge in British Columbia, embodying the same idea, except that it has a stern paddle wheel with separate propelling machinery, which enables it to go from bar to bar under its own power and at considerable saving, not alone during transit, but at a saving besides on the initial investment for a tug boat.

Should New York proceed in a logical manner with a comprehensive plan for coordinating the harbor facilities of "Greatest" New York, then such modern plant must be employed in filling in thousands of acres required for new Industrial and Free Port districts. Seattle, now a city of about 400,000 people, began such improvements when having a population of only 80,000. Why then should New York, a city of really 8,000,000 people, hesitate to begin a similar improvement which is obviously necessary?

Floors Made of Wood Blocks

(*Concluded from page 357*)

deficient. There is a species of pine native in Southern Missouri and Arkansas that is largely substituted for long-leaf in block manufacture. It runs very close grain, clear and takes treatment readily; but according to one authority, however, it does not contain the body that gives long-leaf its great resistance to end compression. The fact that it is close grained allows its substitution for long-leaf, but its lack of strength causes it to break up under loads in floor service.

Wood blocks must be all sound, square-edged, free from bark, loose or rotten knots or any other defects detrimental to their strength and durability. The timber should be properly air-dried, which condition is necessary in order to secure a rapid, thorough penetration of the wood cells in the creosoting process.

A certain manufacturer of wood block-flooring originated the use of empty cell, specially treated block for floor construction, and the results obtained with his floors are said to bear witness that this is the proper method. Blocks so formed show a minimum of shrinkage when installed in a floor. The creosote used by this same manufacturer is a pure dead oil, a distillate of coal gas or coke oven tar, and is a product obtained only by distillation. It is entirely free from admixture of tar, tar oils, petroleum or any other product. Those, however, who are familiar with preserving methods, judge values by the quality of the preservative and the uniformity of the penetration secured. Sufficient pressure is used to secure uniformly perfect penetration, making the blocks proof against decay and the harmful action of oils, acid, or alkali solutions and highly fire-resistant, but without diminishing the compressive strength of the wood.

A Standard Size for Catalogs

ALL catalogs intended for preservation by purchasing agents are hereafter to be limited to one size, according to plans laid by the National Association of Purchasing Agents. A committee of this association has called a conference to discuss the matter in Chicago on May 22d.

At first the opinions of those affected by the suggestion were diversified; many expressed the idea that one size for all was impracticable. But the purchasing agents are determined to rid themselves of the nuisance caused by the retention of hundreds of different catalogs of hundreds of styles and sizes. They have decided to adopt the one uniform size, for which they will provide filing space; and catalogs which do not fit the files will have to take their chances. Under these circumstances, once the standard size is decided on, it is believed that the catalog issuers will soon see the advisability of conforming.

It is emphasized that this expense will be only initial. Those conversant with the printing industry estimate that the abandonement of the heterogeneous sizes will effect a saving throughout the year of close to a million dollars in reduction and standardization of printing and folding equipment; and such a saving, of course, is bound to get back to the consumer—the issuer of catalogs and the purchasing agent himself, who, in the last analysis, is the buyer of catalogs.

Just what the standard size will be is not determined, and will not be without the fullest consideration of all the points involved, which are numerous and complicated. Those interested in the matter are invited to communicate with the Chairman of the Committee, W. L. Chandler, the Dodge Co., Mishawaka, Ind.

Twins—a scrap of *loyal* paper and a tin of *fighting* ink! Dark blue, tissue-thin and parchment-tough, is the wonder-working stencil. And by it is the fine art of Mimeographing *revolutionized*—when it is put into service with its natural affinity, *Mimeograph ink*. These twin supplies are made by us to work together. Upset that relationship, the work suffers, valuable time and materials are lost, and our responsibility for quality and output ceases. ☛ ☚ With them *duplicating* takes on a new significance. Not only do they quickly reproduce work matching the neatest typewriting, but by their ability to easily and cheaply duplicate drawings of all kinds they open up new channels of usefulness. Let us show you what they can do to help you in your work. Booklet "A4" explains. A. B. Dick Company, Chicago—and New York.

MIMEOGRAPH

LAPIDOLITH

TRADE MARK

Buy a
Liberty Loan Bond

Back our Government with your dollars.

This is an investment, not a gift. The security is sure and the rate of interest high.

L. SONNEBORN SONS, Inc.
Makers of Lapidolith and Cemcoat
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New York

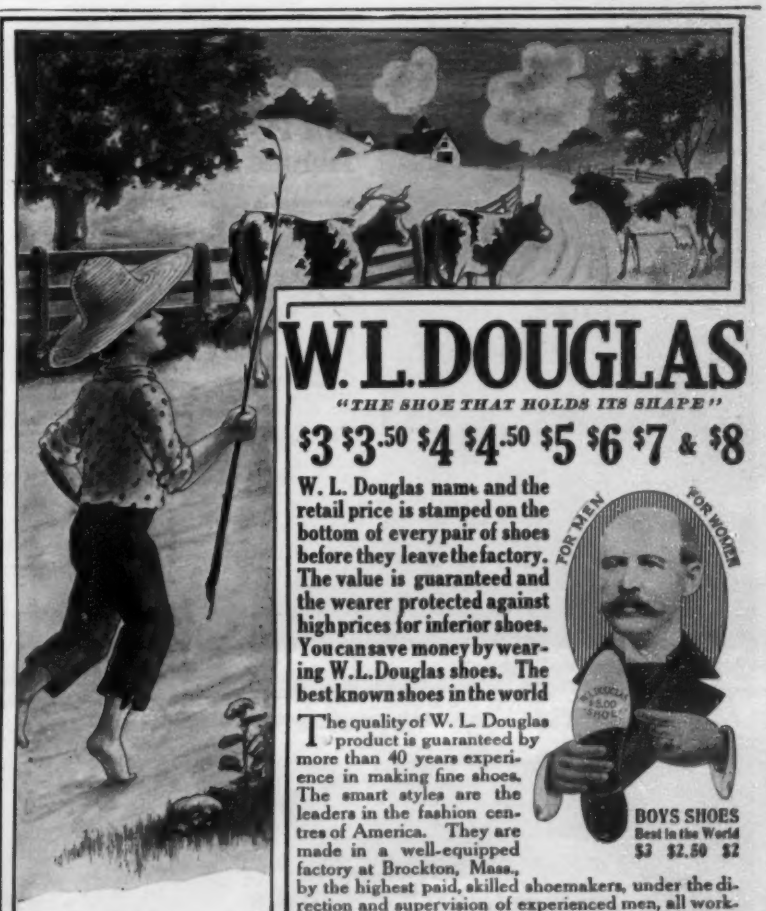
For All Concrete Floors

AUTOMATIC IGNITION
CONNECTICUT

ITS MARK OF IDENTIFICATION

Scientifically Developed

CONNECTICUT TELEPHONE & ELECTRIC COMPANY
MERIDEN CONN.



Getting up early in the morning, milking the cows and driving them to pasture were tasks which W. L. Douglas was called upon to perform while "bound out," learning the trade of shoemaking.

Copyright, W. L. Douglas Shoe Co.

W. L. DOUGLAS

"THE SHOE THAT HOLDS ITS SHAPE"

$3 $3.50 $4 $4.50 $5 $6 $7 & $8

W. L. Douglas name and the retail price is stamped on the bottom of every pair of shoes before they leave the factory. The value is guaranteed and the wearer protected against high prices for inferior shoes. You can save money by wearing W. L. Douglas shoes. The best known shoes in the world

BOYS SHOES
Best in the World
$3 $2.50 $2

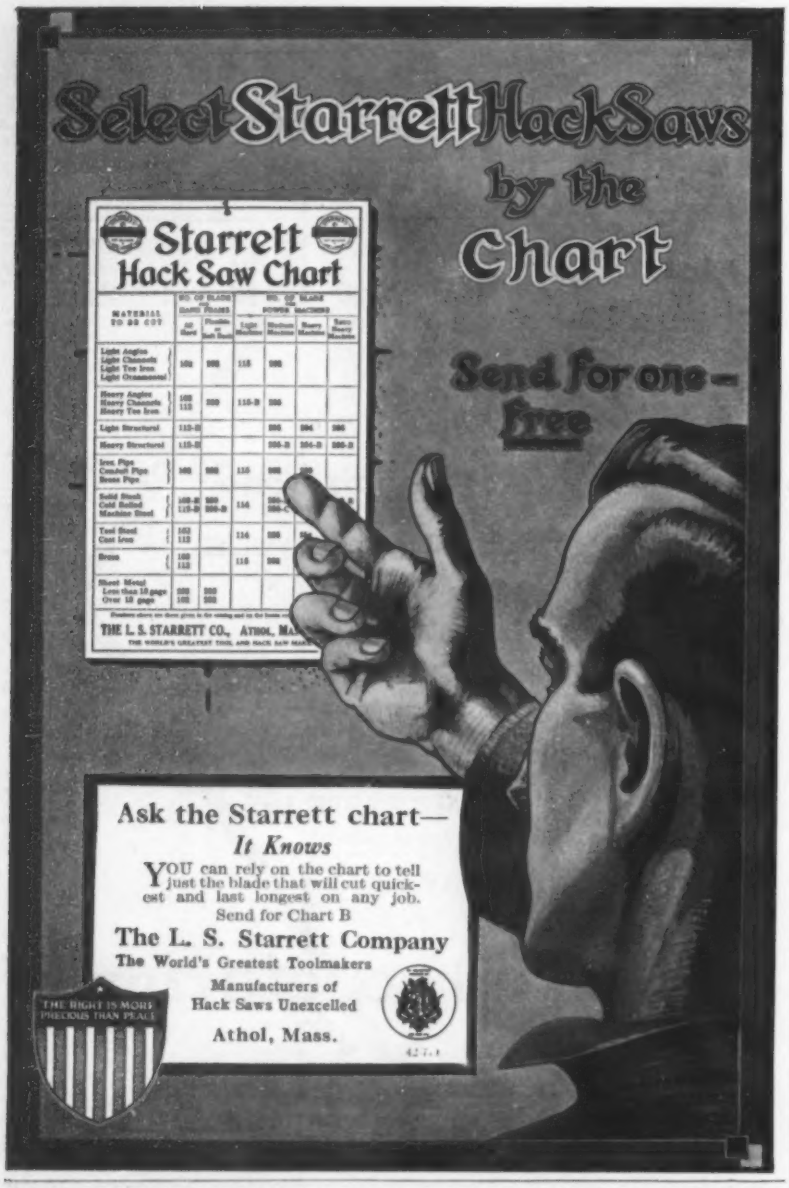
The quality of W. L. Douglas product is guaranteed by more than 40 years experience in making fine shoes. The smart styles are the leaders in the fashion centres of America. They are made in a well-equipped factory at Brockton, Mass., by the highest paid, skilled shoemakers, under the direction and supervision of experienced men, all working with an honest determination to make the best shoes for the price that money can buy.

The retail prices are the same everywhere. They cost no more in San Francisco than they do in New York. They are always worth the price paid for them.

CAUTION—Before you buy be sure W. L. Douglas name and the retail price is stamped on the bottom and the inside top facing. This is your only protection against high prices for inferior shoes. BEWARE OF FRAUD.

Sold by over 9000 shoe dealers and 105 W. L. Douglas stores. If not convenient to call at W. L. Douglas store, ask your local dealer for them. Take no other make. Write for booklet, showing how to order shoes by mail, postage free.

President
W. L. DOUGLAS SHOE CO.
163 Spark St., Brockton, Mass.


Select Starrett Hack Saws by the Chart
Starrett Hack Saw Chart
Send for one—free
Ask the Starrett chart—
It Knows
YOU can rely on the chart to tell just the blade that will cut quickest and last longest on any job.
Send for Chart B
The L. S. Starrett Company
The World's Greatest Toolmakers
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Hack Saws Unexcelled
Athol, Mass.
THE RIGHT IS MORE PRECIOUS THAN PEACE

The Power to Win—Abroad and at Home
Every day of the Great War demonstrates more forcibly the value of motor-power. Aeroplane and tank, passenger-car, and motor-truck—all are the children of the motor; all supplement indispensably the power of man.
No less in America does the motor manifest its power for good. No individual owns a motor car but is the better, the bigger for it. No business uses a motor-truck but thereby increases its efficiency. Already our nearly five-million motor vehicles annually carry many more passengers than all our rail-roads, and do more than half as much haulage.
Among all motors, the Continental has won the pinnacle place and maintains it unchallenged. Your purchase of a Continental-equipped car or truck will increase your power to win!
CONTINENTAL MOTORS CORPORATION
Offices: Detroit, Michigan
Factories: Detroit, Muskegon
Largest exclusive motor manufacturers in the world
Continental Motors

Digging Holes with a Pile Driver

(*Concluded from page 357*)

with the clutch may be used any one of several hammer-heads. In the first place, there is a perforating hammer of conical shape, weighing about two and a half tons, and some thirty-three inches in diameter at its base. This has a point of high grade steel. Then there is the packing hammer of cast iron, ogival in shape—like an inverted Gothic arch—three or four inches smaller than the borer, and weighing about two tons. Finally there is a finishing hammer in the form of a truncated cone; this is used with its smaller base upward, unlike the two others, which work with the point down.

Each of these heads is provided with a stock shaped like a child's top. The clutch, already mentioned, grips this tapering top firmly. When the windlass is wound up, the clutch rises, carrying the hammer head upward with it. But the upper part of the clutch is fatter than the lower part, and consists of several jaws neatly arranged so that pressure upon them will open the clutch below and allow the hammer head to fall.

Attached to the framework of the carriage there is a wooden block, shaped like an inverted funnel. This may be adjusted to any desired height; but it always stands directly in the path of the rising clutch—the tackle passing through it by virtue of holes provided for that purpose. The engineer in charge decides the height from which the hammer head must fall to do the desired work, and fixes this block at that height. Then, when the clutch is brought up by the windlass, it comes in contact with the block, its upper works pass into the funnel and, as soon as the resulting pinch is felt, the clutch is tripped open—and the hammer falls freely down the chute to deliver its blow. The clutch, equipped with a spring which causes it to grip the shank of the hammer automatically, is then lowered into the hole; the hammer is seized, and raised on high for another descent. The engineer in charge judges when the hole is sufficiently deep by noting the gradual diminution in the distance which the head penetrates with each blow.

It is now necessary to proceed with the tamping which, in addition to giving the desired vertical and lateral compression of the earth about the hole, has also the object of providing a base for the column. For this there is thrown into the bottom of the hole a quantity of rubble and stones, mixed with mortar in such a way as to make the whole, in effect, a sort of slow-setting cement. Under the blows of the tamping hammer this mass gradually forces the bottom of the hole out flatter and flatter; but the resistance offered by the already partly compacted earth is sufficient also to spread the cement plug out sideways. The result is a solid block in the bottom of the hole, certainly of diameter equal to that of the main bore, frequently, when the soil is a trifle soft, exceeding that diameter. Moreover, the foundation thus formed for the column that will fill the hole, while substantially flat of bottom, has, where the extreme point of the original hole stood, a little projecting point—for the bottom soil has become so well packed as to refuse compression down to the ultimate level attained by the vertex of the perforating cone. This little knob is found to be of great value in resisting lateral stresses which may occur.

Once the base is thus properly in place and shaped, the column above it is formed by filling the hole with any appropriate concrete mixture. This is put down in layers, about a foot thick, which are tamped in place with the same packing hammer already used. Under this treatment, the material penetrates the earth walls of the holes to a considerable extent, forming little extruded secondary bases of support which aid greatly in the distribution of the load, throwing a very appeciable part of it back upon the ground adjoining the column, instead of carrying it all straight down to be borne by the section immediately beneath. Finally the compression of the material in the column

To the man of affairs who is answering his country's call to arms

"The Management of Your Estate" is a twenty-page booklet describing the services performed by this company. It will interest every man who is giving thought to the safeguarding of his business interests while in the service of his country. We will gladly mail you a copy upon request. Further details will be cheerfully given by the officials of this company at our main office or at either of our uptown branches.

Union Trust Company
of New York
80 Broadway
786 Fifth Ave. 425 Fifth Avenue
Capital and Surplus, $8,500,000.

Make Supplies Go Further

Mileage costs vary with the way your trucks are operated, and the brands of fuel, oil, tires, etc. used. *Watch your per-mile costs under all conditions* and you'll know where money and materials can be *saved.* Take your records of distance from a

Veeder
HUB ODOMETER

Seals onto the hub; can't be made to read falsely. Do not fail to note the great ruggedness of the RECORDING MECHANISM. Always ***adds*** *mileage, whether truck runs forward or backward. Price, $20. Ask for descriptive leaflet.*

THE VEEDER MFG. CO.
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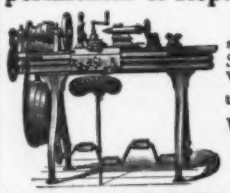
LATHES AND SMALL TOOLS

For Gunsmiths, Tool Makers, Experimental & Repair Work, etc.



From 9-in. to 18-in. swing. Arranged for Steam or Foot Power, Velocipede or Stand-up Treadle.

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SOUTH BEND LATHES
Established in 1906 Making Lathes over 10 years

For the Machine and Repair Shop
LOW IN PRICE
13 in. to 24 in. swing
Straight or Gap Beds
Send for free catalog giving prices on entire line
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ESTABLISHED 1867 166 W. MADISON ST. CHICAGO, ILL.
WRITE FOR CATALOGUE OF MODEL SUPPLIES

Valuable Books of Instruction and Reference

Scientific American Cyclopedia of Formulas—Concrete Pottery and Garden Furniture—Scientific American Reference Book—Experimental Science—Handy Man's Workshop and Laboratory

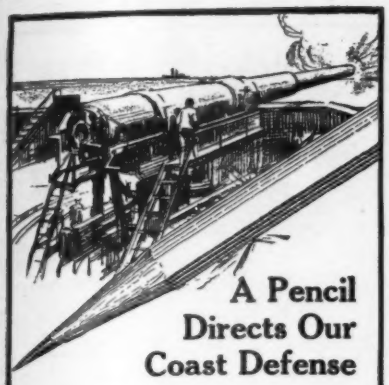
MUNN & CO., Inc., *Publishers*, Woolworth Bldg., New York

American Beauty **Electric Heating Devices**
FOR INDUSTRIAL USE

Soldering Irons, Air Heaters
Glue Pots Laboratory Plates

They Speed Production

American Electrical Heater Company
DETROIT, U. S. A.



A Pencil Directs Our Coast Defense

Intricate fortification plans and big-gun charts must be drawn with a dependable pencil. The importance of a strong, smooth, long-wearing lead can hardly be overestimated.

DIXON'S
ELDORADO
"the master drawing pencil"

has proved itself *"the master drawing pencil"* in every case. No work is too hard, no lines too fine, no shading too difficult.

Made in 17 degrees, each true to grade.

Send 16 cents in stamps for samples worth double the money.

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Dept. 121-J, Jersey City, N. J.

DIXON'S BEST WHITE No 352
writes white on blueprints

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PARKER, STEARNS & CO.,
286-300 Sheffield Ave., Brooklyn, N. Y.

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NO OTHER TYPEWRITER CAN DO THIS---

Change instantly from
Miniature Roman to Large Gothic
Medium Roman to *Italics*
Vertical Script to CLARENDON
English to Beyrna RUSSIAN
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This can be done by "Just turning the knob" on the

MULTIPLEX HAMMOND
"WRITING MACHINE"

Two type-sets always on the machine. A Special Type for Every Language, Business, Profession, and Science—*instantly changeable!* Write at once for illustrated Folder. Learn what the 16 things are which can be done on the Multiplex Hammond, *but on no other typewriter!*

A NEW PORTABLE
Condensed Aluminum
ONLY 11 POUNDS
FULL CAPACITY
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is completed by using the flat-bottomed hammer against the exposed upper surface; and the pillar is then ready to receive its permanent load.

Naturally the holes are spaced according to the structure to be supported and the nature of the ground. When they are very close, the pillars expand as they go down and finally join at a depth of twelve to eighteen yards, forming a sort of framework of extreme solidity. Again, metal braces can be incorporated in the mass of concrete, projecting out to the sides, and if it be desirable, making it possible to tie the pillars together with arches or beams of reinforced concrete, forming a squared groundwork. In this way the proper distribution of the load between all the columns is assured, and the arches or beams afford a system of tie-bars rendering the whole foundation solid to an extraordinary point. This framework, working like a pair of shears, can even take up a considerable horizontal stress.

The Current Supplement

ONE of the benefits resulting from the war, and one that will be of lasting effect, is that it has compelled every country to realize the necessity of fully utilizing its own natural resources, that it may be self-sustaining and not dependent on other countries for what it could, with advantage produce for itself. One of the most important resources of every country is its plant products, and a careful study of the situation is frequently arouses astonishment at the possibilities that have been overlooked or neglected. In a systematic reorganization of our plant industries consideration should be given to the growing of each variety of plant in soil, and under climatic conditions, that will be most effective in results, and in this connection is a paper on *Present Day Problems of Plant Geography*, in the current issue of the SCIENTIFIC AMERICAN SUPPLEMENT, No. 2207, for April 20th. The bombardment of Paris by a new gun of sensational range has aroused widespread comment. The probable principles of its construction have been discussed in the columns of the SCIENTIFIC AMERICAN but some notes on experiments made in this country years ago, in which these principles were involved, will be found in an article entitled *The New German Schreckliche Gun*, in this issue of the SUPPLEMENT, which shows sketches of the devices in question. Another installment of the series of papers on *Anomalies of Animal Life* will be found in this issue. *Wax Modeling from Nature* describes and illustrates a diversion that will be pleasing to many, and contains suggestions that may be useful to many naturalists. The paper on *Unsinkable Ships* is concluded this week. *The Study of Indian Music* describes some recent developments through a new system of analysis which will be found extremely interesting to both students of music and ethnology. Another important paper is on *Light Projection*, which reviews the history of the art, with notes on various devices employed. Other articles include *The Hypo Scarcity*, and *A Typical British Locomotive*, which illustrates and describes one of the latest improved designs now in use in England.

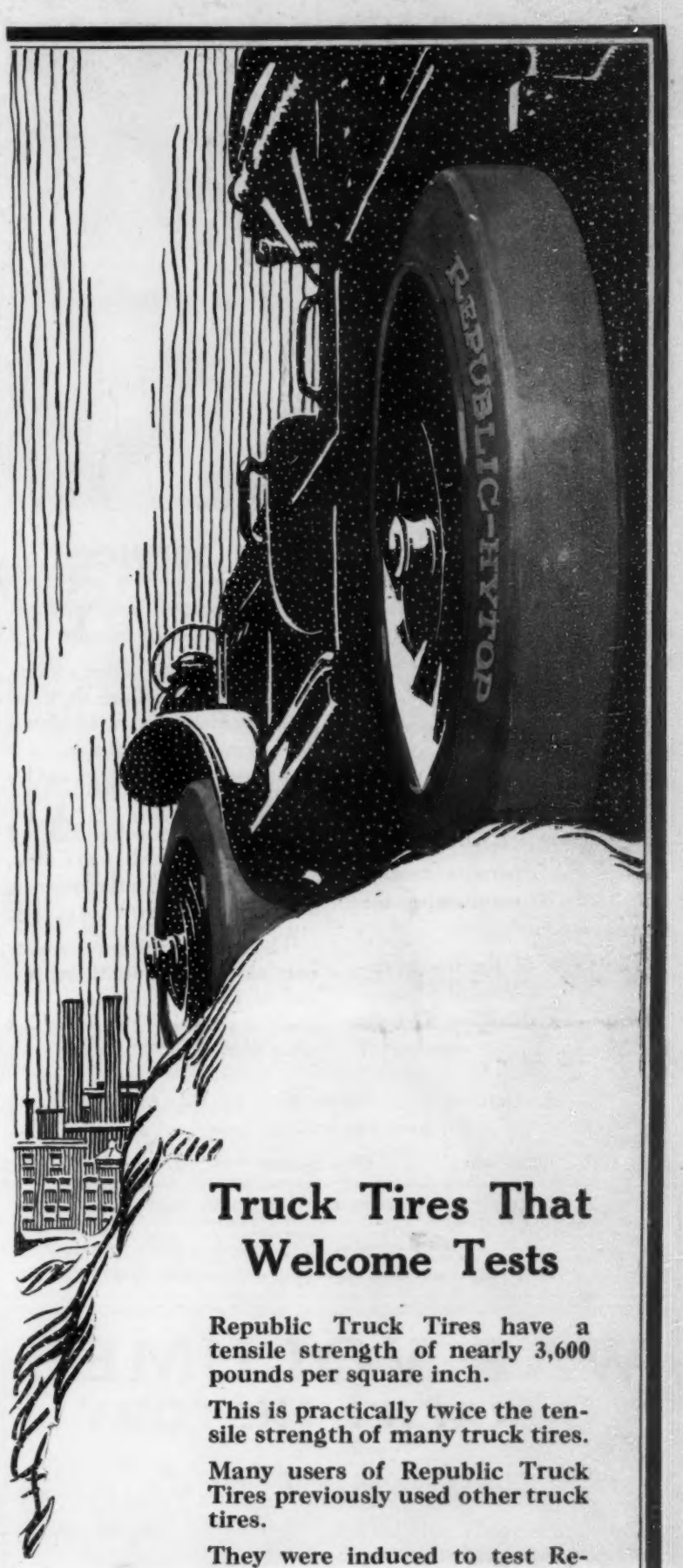
Geology in the War

(Concluded from page 353)

when the Germans discovered what was going on. Countermines were begun, but the Germans, less well supplied either with data or with geologists, encountered quicksands that made further progress impossible. The British saps were driven into the very heart of the ridge. More than fifty high-explosive mines were planted, containing several tons of T. N. T., and on June 7th, with a detonation that shook the earth for miles around, the mines were exploded.

What had been the crest of the Messines Ridge became a crater. Hundreds of Germans were killed and some 7,500 prisoners and 47 guns taken by the British who have since held the captured position.

While this was the most spectacular feat of the geologists, some of them of world-wide reputation, whose services to



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the Allies have been very real and constant, their exact knowledge of subterranean conditions is continually being turned to a variety of uses. With every change in the positions of the opposing forces on any sector of the front, new maps are prepared, on which data of use to a commanding officer is indicated by means of vari-colored inks and symbols. One color, for example, indicates "Here it is safe to build dugouts," while another indicates "No chance for dugouts here—rock five feet below the surface." Trench locations, favorable and unfavorable, are indicated, with quicksands, chalk-beds, caves and other subterranean phenomena. As the water supply of the forces in the field is of the greatest importance, every point at which the geological indications point to the obtaining of water by digging is carefully indicated on these maps, which also show where it is safe to dig mines and tunnels.

Since there is a considerable body of underground flowing water throughout Northern France, vertical cross-sections of the terrain at various points have been drawn, in order that these underground water systems may be studied and the probable rise and fall of subterranean rivers and lakes be anticipated before such movements interfere with tunneling operations or make dugouts and shelters uninhabitable.

A recent observer has stated that "every man of note in the scientific life of England is at work for his country and there is no branch of science that is not being applied in this war." The utilization of geology on any such scale, at least, is certainly unique in the history of warfare. Germany in the beginning of the war called its scientists to the aid of the army. Today, however, conditions are reversed, and men of science are playing by far a greater part in the councils of the Allies than in Germany's.

Are We Wasting Our Petroleum?

WITH our automobile industry turning out every year 1,500,000 new cars, the question of how to provide fuel for all of them is becoming a problem of increasing difficulty. Gasoline is not a material of which an unlimited supply is obtainable, and we need at least 2,000,000,000 gallons every year and may need still more in the future. Our supply would be safer if we would be more sparing with our petroleum than we are today.

It is figured out by the Bureau of Mines, that 2,750,000,000 barrels petroleum have been produced in this country since Col. Drake drilled his first oil well in the year 1859. If the estimates are correct, there are still approximately 7,402,000,000 barrels in the ground which can be made available for industrial and general purposes.

What is taken from the wells at present is not always used to best advantage. In fact, we are burning our oil very much in the fashion of the foolish virgins. Twenty-five per cent of the yearly production of petroleum is consumed today as fuel under boilers where probably other fuel could be used to better advantage, and it is estimated that nearly seventy per cent of this valuable fluid is used uneconomically.

But waste does not only lessen the profit we should derive from our petroleum resources; it also attacks the equally valuable resources of natural gas escaping from the wells. During 1914, for instance, 1,218,000,000 cubic feet of gas were permitted to escape from one well alone. This represents a financial loss of $182,700 or five times the cost of drilling an average oil well. The gas gone to waste in this way would have been sufficient to provide all the gas needed during six months by a city like Albany or Fall River. It is reported that four wells alone wasted 5,000,000,000 cubic feet of gas, while the total loss to the nation from this negligence amounted to 100,000,000,00 cubic feet during the year 1913.

This, at the consumers' rate of gas, means that $15,000,000,000 have been blown into the air. This appalling waste becomes still more evident if one considers that in this way $75,000 was squandered every day in order to obtain a daily oil production valued at $25,000.

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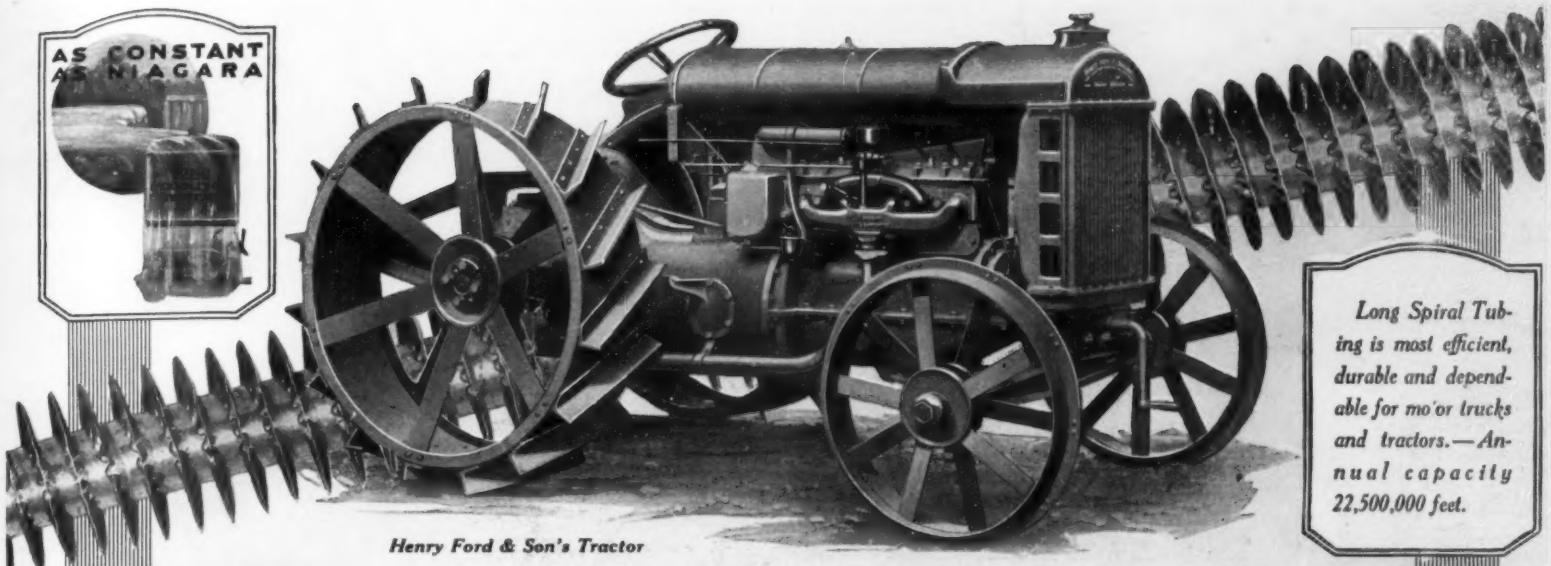

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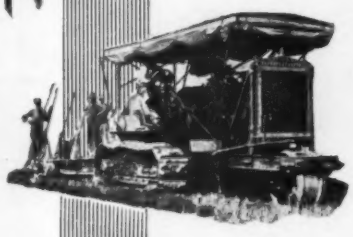

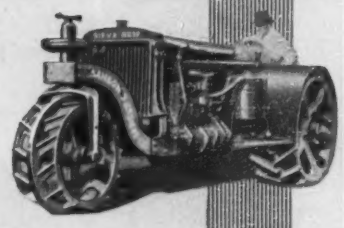

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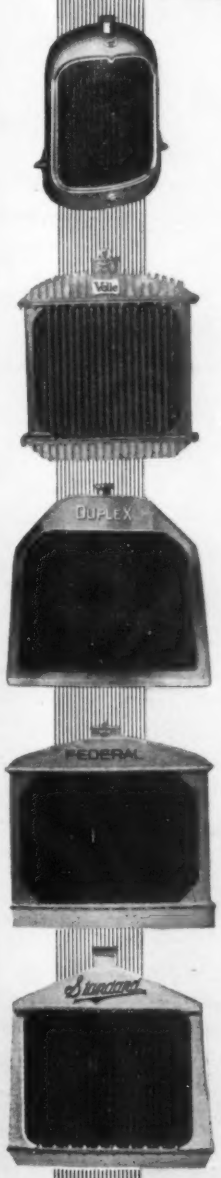

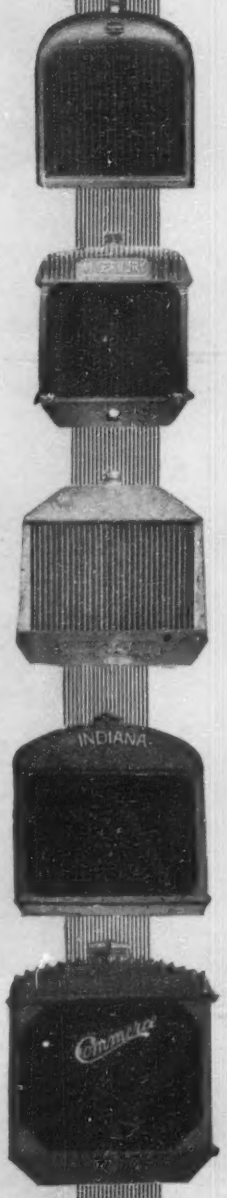

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SCIENTIFIC AMERICAN

A NARROW ESCAPE FROM A GERMAN RUSE: THE DECOY PERISCOPE MINE [See page 383]

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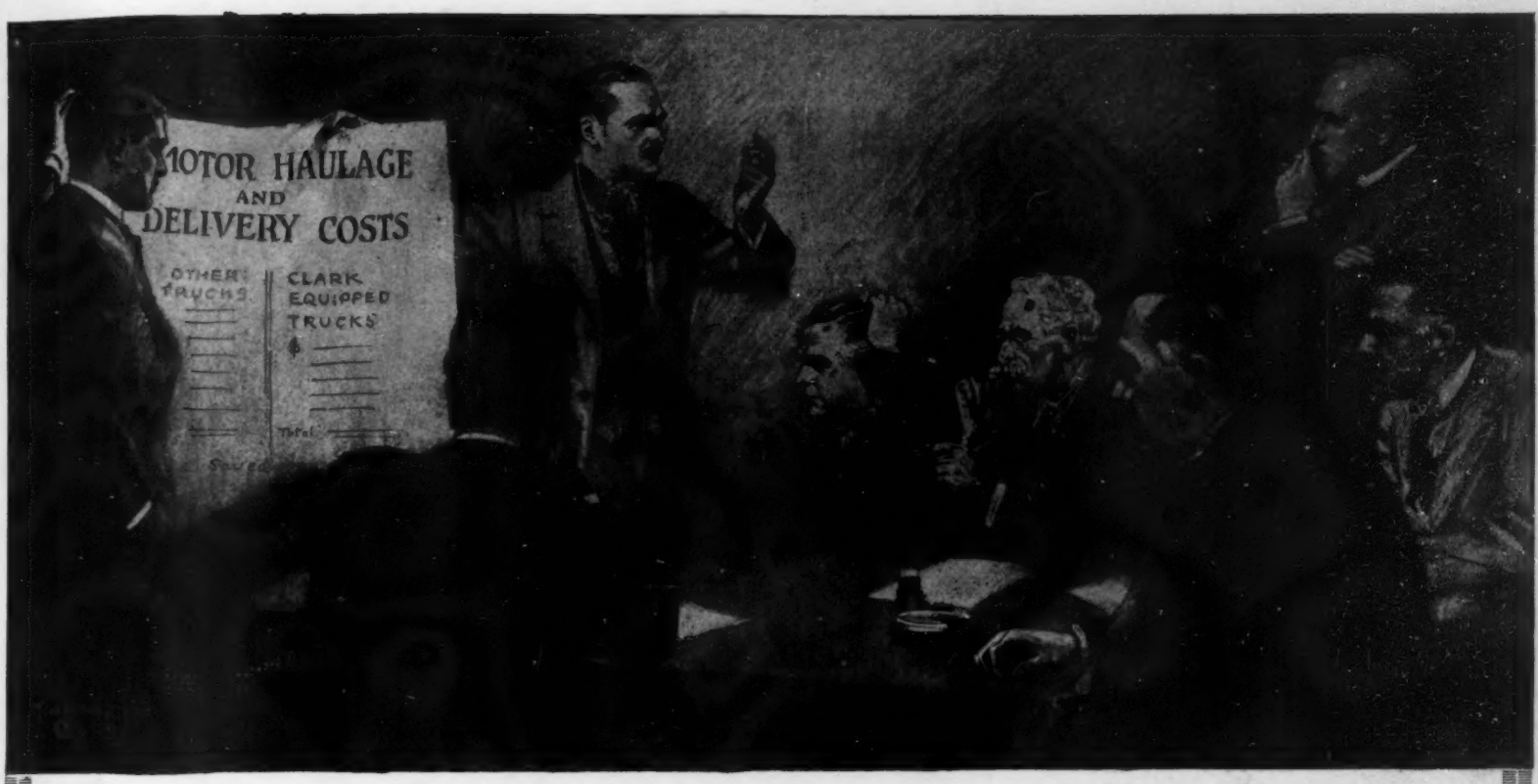

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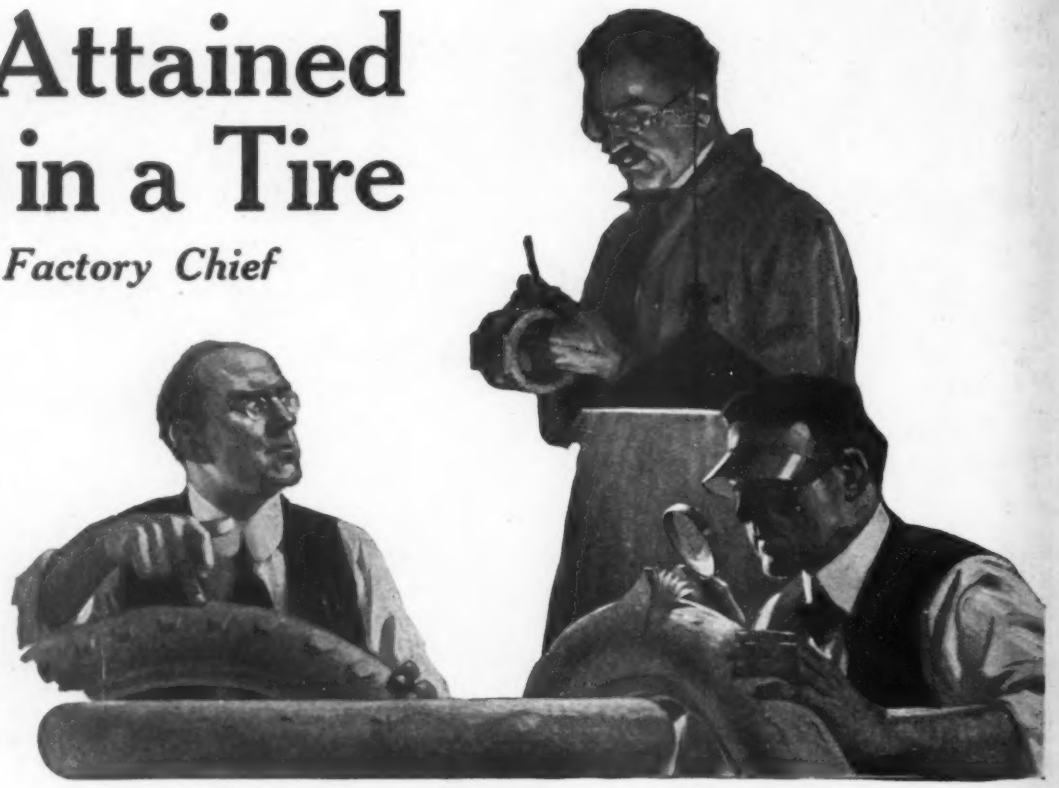

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